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Feasibility of creating an enriched environment and subsequent impact on activity levels for stroke patients in an acute stroke unit

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B.Phty

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Abstract

Individuals with stroke in an acute stroke unit spend the majority of their day inactive and alone. There is strong evidence that greater physical activity, and emerging evidence that greater social and cognitive activity after stroke promotes functional recovery. One approach found to increase activity levels in all these activity domains following stroke is an enriched environment, which is an intervention designed to stimulate physical, social and cognitive activity. The enriched environment is well investigated in animal models post stroke and refers to housing conditions that are designed to stimulate motor and sensory functions, as well as social and cognitive activity. Evidence has shown that rodents recovering within an enriched environment starting 24-hours post stroke showed greater functional recovery than recovery in standard housing conditions. The first clinical translation of an enriched environment was undertaken in the subacute inpatient rehabilitation setting, which showed that individuals with stroke (n=14) undergoing enriched rehabilitation were 1.2 times more engaged in 'any activity' as compared to no enrichment. However, the enriched environment has not yet been explored in an acute stroke unit. Thus, the primary aim of this thesis was to investigate whether an enriched environment embedded in an acute stroke unit could increase activity levels in physical, social, cognitive and combined activity domains across individuals with acute stroke.

Study 1 examined the effect of embedding an enriched environment in an acute stroke unit on activity levels using a controlled before-after observational design. Activity levels were observed in a control group receiving usual care, and subsequently in a group who recovered in an enriched acute stroke unit. The enriched environment focused on three key areas: 1) creating a stimulating environment including communal areas for eating, socialising and group activities, and provision of resources throughout the ward and at the patient bedside; 2) involvement of patients and families to increase activity outside therapy hours, and 3) using change management strategies to support staff to implement the enriched environment within existing staffing levels. Behavioural mapping was used to determine the primary outcome measure 'any', physical, social and cognitive activity. Participants were observed every 10-minutes from 7.30am till 7.30pm on weekday and weekends. We found that the enriched group (n=30) spent a significantly greater proportion of their day engaged in 'any activity' ($p=0.005$), physical ($p<0.001$), social ($p=0.007$) and cognitive activity ($p=0.002$) as compared to the control group (n=30). Furthermore, the enriched group spent a lower proportion in a supine position, in their room and being alone. The secondary aims were to explore the impact of an enriched environment on functional outcomes, adverse events and length of stay. No differences between groups were found for functional outcomes at discharge from the acute

stroke unit and at 3-months post stroke. The enriched group experienced fewer adverse events (p=0.001) and a shorter length of stay (p=0.02).

In study 2, the aim was to determine if increased activity levels were sustained 3-months after completion of the before-after pilot study. After completion of study 1, the environmental enrichment was continued in the acute stroke unit, but change management strategies to support staff were withdrawn. Thirty stroke patients were recruited to the sustainability group. Increased patient activity levels were sustained 6-months post implementation of the enriched environment.

In study 3 the impact of the enriched environment on timing and nature of activity levels, and the amount of staff assistance provided to patients to undertake activities was examined. We specified time periods to determine the effect of enrichment strategies on activity levels. Activity was significantly increased during periods of scheduled communal activity, weekday hours outside scheduled activity and weekends, but no effect was observed on weekdays after 5pm. Specific activities, which increased significantly, included upper limb, communal socialising, listening and iPad activities. No difference in amount of staff assistance was observed during activities.

In study 4, nursing and allied health professionals (n=10) were interviewed to evaluate their perceptions and experiences while working in an enriched environment. Thematic analysis showed that staff perceived the enriched environment to make a positive contribution to recovery after stroke and that interdisciplinary teamwork was more visible. Staff surveys supported this view. In addition, staff experienced that change management strategies were critical to not relapse into old work routine. Brief patients and carers surveys showed that consumers appeared to be positive towards the enriched environment in the acute stroke unit.

Taken together, these studies demonstrated that embedding an enriched environment into an acute stroke unit was feasible, significantly increased activity levels in individuals with stroke and activity levels were sustained 6-months post implementation. Furthermore, staff perceived that the enriched environment made a positive contribution to patient recovery after stroke. The promising results of an enriched environment in an acute stroke unit warrant larger studies to determine our ultimate goal: can an enriched environment result in greater functional recovery after stroke.

Declaration by author

This thesis is composed of my original work, and contains no material previously published or written by another person except where due reference has been made in the text. I have clearly stated the contribution by others to jointly-authored works that I have included in my thesis.

I have clearly stated the contribution of others to my thesis as a whole, including statistical assistance, survey design, data analysis, significant technical procedures, professional editorial advice, financial support and any other original research work used or reported in my thesis. The content of my thesis is the result of work I have carried out since the commencement of my higher degree by research candidature and does not include a substantial part of work that has been submitted to qualify for the award of any other degree or diploma in any university or other tertiary institution. I have clearly stated which parts of my thesis, if any, have been submitted to qualify for another award.

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Ingrid Rosbergen-Wildemors

Publications during candidature

Peer reviewed publications

Rosbergen ICM, Grimley RS, Hayward KS, Walker KC, Rowley D, Campbell AM, McGufficke S, Robertson ST, Trinder J, Janssen H, Brauer SG. The effect of an enriched environment on activity levels in people with stroke in an Acute Stroke Unit: A study protocol. *Pilot and Feasibility Studies* 2016;2(1):36. https://pilotfeasibilitystudies.biomedcentral.com/articles/10.1186/s40814-016-0081-z

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Conference abstract publications

Rosbergen, I.C.M., Grimley, R., Hayward, K.S., Walker, K., Rowley, D., Campbell, A., McGufficke, S., Robertson, S., Trinder, J., Brauer, S.G. Feasibility of creating an enriched environment and subsequent impact on activity levels for stroke patients in an acute stroke unit; A study protocol. *International Journal of Stroke 2014, 9, issue S1, 37-38*

ICM Rosbergen, R S Grimley, K S Hayward, K Walker, D Rowley, A Campbell, S McGufficke, S Robertson, J Trinder, S G Brauer. Stroke patients in an acute stroke unit show little physical, social and cognitive activity. *International Journal of Stroke 2015, 10, (suppl 2); 77-438*

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Rosbergen I, Brauer SG, Fitzhenry S, Grimley RS, Hayward KS, Staff perspective of working in an enriched environment embedded in the Acute Stroke Unit. *International Journal of Stroke* 2017, Vol. 12(3S) p14

Rosbergen I, Grimley RS, Hayward KS, Walker KC, Rowley D, Campbell AM, McGufficke S, Roberston ST, Trinder J, Janssen H, Brauer SG. Are the effects of an enriched environment on patient activity sustained over time in an acute stroke unit? *International Journal of Stroke* 2017, Vol. 12(3S) 10

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Contributor	Statement of contribution
Author Ingrid CM Rosbergen	Study design (50%) Intervention and data collection (70%) Statistical analysis (80%) Authored the paper (70%) Edited the paper (65%)
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Author Rohan S Grimley	Study design (15%) Authored the paper (10%) Edited paper (10%)
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Author Sarah Fitzhenry	Study design (5%) Statistical analysis (15%) Edited paper (5%)
Author Rohan S Grimley	Study design (10%) Authored the paper (5%) Edited paper (5%)

Contributions by others to the thesis

The PhD candidate, also chief investigator was primarily responsible for design of the studies, gaining ethical approval, participant recruitment, data collection, data analysis and interpretation and manuscript preparation.

Principal Investigators Professor Sandra Brauer, Dr Rohan Grimley and Dr Kathryn Hayward had substantial input in the design and development of the study 'The effect of an enriched environment on activity levels in people with stroke in an Acute Stroke Unit' and in obtaining grant funding.

Professor Sandra Brauer, Dr Rohan Grimley and Dr Kathryn Hayward had substantial input into the critical appraisal of this written work, which includes design, development, data collection, data entry, statistical interpretation and publications.

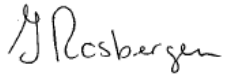
Dr Heidi Janssen and Dr Kathryn Hayward had substantial input into the development of the behavioural mapping protocol and Dr Kathryn Hayward contributed to training staff members into the behavioural mapping method.

Dr Kathryn Hayward had substantial input in the qualitative study, and Ms Sarah Fitzhenry contributed to data collection and interpretation for the qualitative study.

Associate investigators Mrs Katrina Walker, Mrs Donna Rowley, Mrs Alana Campbell, Mrs Suzanne McGufficke, Mrs Samantha Robertson and Mrs Janelle Trinder had input in design, development and implementation of the enriched environment on the Acute Stroke Unit including data collection. Mrs Katrina Walker and Mrs Alana Campbell contributed to recruitment for the pilot study. Mrs Janelle Trinder contributed to development of surveys and data collection.

To the best of my knowledge and belief, no person who has offered contributions consistent with the above has been excluded as an author. Persons who have contributed to the work but not at the level, which constitutes authorship, have been acknowledged in the text.

Mrs Ingrid Rosbergen



Professor Sandra Brauer

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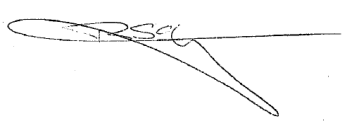

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Statement of parts of the thesis submitted to qualify for the award of another degree

None

Research Involving Human or Animal Subjects

This research involved human subjects. We received written approval from the following ethic committees.

1. Human Research Ethics Committee,

Metro North Hospital and Health Service,

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2. Medical Research Ethics Committee

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The University of Queensland, Brisbane Qld, 4072

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Table of Contents

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List of Abbreviations used in the thesis

ABI	Acquired brain injury
ADL	Activities of daily living
AE	Adverse events
AH	Allied health
AHA	Allied health assistant
AIHW	Australian institute of health and welfare
Am	Ante meridiem
ANCOVA	Analysis of covariance
ANZCTR	Australian New Zealand clinical trial registry
ASU	Acute stroke unit
AUSCR	Australian stroke clinical registry
AVERT	A very early rehabilitation trial
BDNF	Brain derived neurotrophic factor
BM	Behavioural mapping
CT	Computed tomography
CI	Confidence interval
EE	Enriched environment
EEG	Electroencephalogram
FAC	Functional ambulatory category
FAME	Fitness and mobility exercise
FTE	Fulltime equivalent
GRASP	Graded repetitive arm supplementary program
HADS	Hospital anxiety and depression scale
HREC	Human research ethics committee
HRQol	Health related quality of life
ICF	International classification of functioning and disability
ICH	Intracerebral haemorrhage
IRR	Incidence rate ratio
IQR	Inter quartile range
LACI	Lacunar infarct
LOS	Length of stay
MBI	Modified barthel index

MREC	Medical research ethics committee
MRI	Magnetic resonance imaging
mRS	Modified rankin scale
MSAS	Mobility scale for acute stroke
n	Number
NIHSS	National institute of health stroke scale
OR	Odds ratio
PACI	Partial anterior circulation infarct
PI	Principal Investigator
Pm	Post meridiem
POCI	Posterior circulation infarct
RCT	Randomised controlled trial
Rt-PA	Recombinant tissue plasminogen activator
SAE	Serious adverse events
SD	Standard deviation
SGA	Subjective global assessment
SRRR	Stroke rehabilitation and recovery roundtable
TACI	Total anterior circulation infarct
TPCH	The Prince Charles Hospital
UC	Usual care
URL	Uniform resource locator
UQ	The University of Queensland
EQ VAS	EuroQol visual analogue scale

Chapter 1 will introduce the reader to the topic of the thesis.

It will present the problem, significance and thesis aims.

Chapter 1 Introduction

1.1 Introduction to the thesis

The burden of stroke in Australia is high. Stroke is defined within the Australian Stroke Foundation guidelines as "a sudden and unexpected damage to brain cells that causes symptoms that last for more than 24 hours in the parts of the body controlled by those cells. Stroke happens when the blood supply to part of the brain is suddenly disrupted, either by blockage of an artery or by bleeding within the brain" (Stroke Foundation, 2017a). It is critical that stroke survivors have access to best quality, evidence-based stroke care to reduce death and improve life after stroke, and the Stroke Foundation commits to yearly national audits in efforts to continuously drive best quality of care across the Australian health care system (Stroke Foundation, 2017b). In 2017 there were 475,000 stroke survivors living in the Australian community, and every nine minutes a person suffers a stroke (Stroke Foundation, 2017c). It is expected that the number of people who experience a stroke will continue to rise given the ageing population, highlighting the ever-increasing burden of stroke for survivors, families and the community (Stroke Foundation, 2017c).

Stroke is a medical emergency and early medical attention after onset is critical. In the last 20 years medical breakthroughs such as intravenous thrombolysis and mechanical endovascular clot retrieval in ischemic stroke have increased the likelihood of survival after stroke, and resulted in reduced disability of stroke survivors at 3-months post stroke (Balami et al., 2015; Campbell et al., 2017; Emberson et al., 2014). The time window for thrombolysis and endovascular clot retrieval is currently narrow: 4.5 hours from stroke symptom onset for thrombolysis, and within six hours for endovascular clot retrieval (Ahmed et al., 2013; Goyal et al., 2016). The 2017 Stroke Foundation audit results showed that only 13% of stroke survivors received thrombolysis in 2016, and 21 acute hospitals across Australia were able to perform mechanical endovascular clot retrieval. This indicates that the majority of stroke survivors were not eligible or had no access to these acute reperfusion interventions (Stroke Foundation, 2017b), and thus were reliant on other interventions including rehabilitation, to support their stroke recovery to maximise function and quality of life.

The Stroke Foundation recommends that all stroke survivors are admitted to hospital, and access acute stroke unit care (Stroke Foundation, 2017a). Access to organised acute stroke unit care has been found to reduce death, disability, and the need for long-term institutional care after stroke compared to general ward care (Stroke Unit Trialists' Collaboration, 2013). Acute stroke unit care is characterised by coordinated multidisciplinary rehabilitation, staff having a specialist interest in

stroke, family involvement in the rehabilitation process, and providing education and training (Stroke Unit Trialists' Collaboration, 2013). Early mobilisation and initiation of rehabilitation are considered essential to how an acute stroke unit leads to better patient outcomes (Quinn et al., 2009). On top of the benefits of stroke unit care, the acute phase after stroke is a sensitive time window for neural repair (Zeiler & Krakauer, 2013). Therefore, Australian Clinical Guidelines for Stroke Management recommend that people with stroke should be admitted to an acute stroke unit preferably within three hours of onset of stroke to achieve the maximum benefit of specialist stroke unit care (Stroke Foundation, 2017a). The Stroke Foundation audit in 2016 showed that 69% of stroke survivors accessed acute stroke unit care in Australia (Stroke Foundation, 2017b). Therefore, there remains considerable room for improvement in equitable access.

Early rehabilitation provided by a specialist multidisciplinary stroke team is a key intervention of acute stroke unit care that focuses on active rehabilitation to promote recovery after stroke (Indredavik et al., 1999). A recent retrospective nationwide study in Japan, which used the Japanese inpatient database (n=100,719), showed that both early (starting within 3 days of admission to hospital), and more intense rehabilitation (>1 hour per day) was independently associated with improved functional outcomes in patients with ischemic stroke (Yagi et al., 2017). It is therefore very concerning that a large and consistent body of evidence has shown that stroke survivors who receive care in an acute stroke unit spent the majority of their time inactive and alone (Bernhardt et al., 2004; Fini et al., 2017; West & Bernhardt, 2012). A recent systematic review reported that stroke survivors spend on average 45% of the time in bed between 8am and 5pm in the acute phase after stroke (Fini et al., 2017). Furthermore, severe stroke survivors spend as much as 95% of their waking hours in bed (Bernhardt et al., 2004). The majority of these studies reported levels of physical activity, and highlight the negative influence of physical inactivity on a stroke survivor's recovery pathway. Inactivity early after stroke has been associated with complications such as falls, pneumonia, urinary tract infection, dehydration, pressure sores and pain (Govan et al., 2007). In support of greater activity, a large systematic review investigating physical therapy (n=467 RCT's) reported that early physical activities targeting mobility, balance and arm-hand function have a favourable effect on regaining functional activities across all phases post stroke (Veerbeek et al., 2014). In spite of evidence suggesting that frequent early activities promote recovery, stroke survivors have been reported to spend only 5.2% of the time between 8am and 5pm receiving therapy while in an acute stroke unit (Bernhardt et al., 2007). To summarise, the high inactivity levels and the short amount of time spent in therapy while in the acute stroke unit suggests that stroke survivors require more opportunities to engage in mobility and upper limb activities to promote early recovery after stroke. In line with this, current guidelines for stroke management around the world recommend early, active, patient-centred rehabilitation in an acute

stroke unit by a multidisciplinary stroke team (Canadian Heart & Stroke Foundation, 2013; Powers et al., 2018; Stroke Foundation, 2017a).

Another key characteristic of acute stroke unit care is an earlier commencement of mobilisation and more time spent mobilising in comparison to general ward care (Kwakkel et al., 2004). Early mobilisation is defined as the commencement of out of bed activities including sitting, standing and walking early after stroke (Langhorne et al., 2017). Early mobilisation has shown to reduce secondary complications after stroke (Govan et al., 2007). However, a large randomised controlled trial (RCT) (n=2104) A Very Early Rehabilitation Trial (AVERT) demonstrated that 'too early and too much' mobilisation post stroke was associated with significantly poorer functional outcomes at 3-months post stroke (AVERT Trial Collaboration group, 2015). A further dose-response analysis of this trial including all participants showed a consistent pattern; shorter and more frequent mobilisation increased the odds of a favourable functional outcome at 3-months (Langhorne et al., 2017). The recent published Australian Clinical Guidelines for Stroke Management (2017) recommend that early mobilisation after stroke should be delivered in shorter, more frequent bouts, and not to start intensive out of bed activities within the first 24-hours after stroke.

Social and cognitive functions are other key areas requiring attention post stroke. There is currently little evidence available on how much social and cognitive activity is performed by a stroke survivor located within an acute stroke unit. High levels of social support are associated with better health-related quality of life in stroke survivors (Kruithof et al., 2013), and some studies suggest that it improves functional status (Glass et al., 1993; Tsouna-Hadjis et al., 2000). It is argued that social support can offer encouragement, assistance, and increase compliance with interventions (Harris et al., 2010; Tsouna-Hadjis et al., 2000), and assist in dealing with the consequences of stroke (Kruithof et al., 2013). Even less evidence is available regarding cognitive activity after stroke. A systematic review of music interventions delivered in hospital, outpatient and community settings showed that music interventions may benefit communication outcomes in stroke survivors with aphasia, and that listening to music may have a positive effect on quality of life of stroke survivors (Magee et al., 2017). Another small study involved reading groups for stroke survivors while in an acute hospital, and found this group activity was perceived positively by stroke survivors to stimulate their mind and promote socialisation (Higgins et al., 2005). Thus, while it appears that it is important to engage in social and cognitive activities early after stroke, there is little data describing how much social and cognitive activity occurs and what approaches are successful in increasing this activity.

Taken together, there is strong evidence that physical, and emerging evidence that social and cognitive stimulation can positively impact on increased activity levels and functional outcomes after stroke. Yet, this is disconnected from current approaches in acute stroke units that demonstrated high levels of inactivity. Therefore, there is a need to identify innovative interventions that may positively influence activity levels across all domains, and concurrently expedite functional recovery after stroke. An enriched environment is such an intervention as it is designed to facilitate activity across domains by creating a stimulating environment (Nithianantharajah & Hannan, 2006). Embedding an enriched environment directly in the acute phase post stroke has the potential to enhance activity levels early and promote greater functional recovery after stroke.

An enriched environment is well researched in animal studies and refers to housing conditions that are constructed to stimulate motor-sensory functions, and social and cognitive activity compared with standard housing (Nithianantharajah & Hannan, 2006). To optimally stimulate activity, the environment is structured to provide sufficient space to promote species-specific behaviour such as the ability to move around freely and encounter social interactions (Nithianantharajah & Hannan, 2006). Furthermore, sensory and motor stimulation is facilitated through provision of equipment such as ladders, ropes, toys, shelters and running wheels (Nithianantharajah & Hannan, 2006). To maintain novelty and complexity of the enriched environment in animal cages, the set-up of stimulating resources within cages is altered regularly (Hannan, 2014). Environmental enrichment in animal models encourages animals to voluntarily engage in their preferred activity and nil coercion is used (Nithianantharajah & Hannan, 2006). A systematic review and meta-analysis investigating an enriched environment in rodents post stroke has shown that animals exposed to an enriched environment post stroke show better sensorimotor function, learning and memory compared to rodents not engaged in an enriched environment (Janssen et al., 2010). In addition, animal models showed that the efficacy of enriched rehabilitation (enriched environment + task specific reaching rehabilitation) for rodents was markedly higher when enriched rehabilitation was started 5-days post stroke as compared to 14-days post onset of stroke (Biernaskie et al., 2004), and was more effective than either enriched environment or task specific rehabilitation alone (Jeffers & Corbett, 2018). The neurobiology underpinning improved functional recovery and learning through engagement in an enriched environment included experience-dependent plasticity, evidenced by increased dendritic spine density and remodelling of cortical maps (Johansson, 2004; Johansson & Belichenko, 2002; Mering & Jolkkonen, 2015). Therefore, rodent models post stroke have demonstrated that an enriched environment has a beneficial effect on functional recovery, which is supported with evidenced biological changes when started early post stroke.

The first translation of an enriched environment within a clinical human population after stroke was performed in the subacute inpatient rehabilitation setting in Australia (Janssen et al., 2014b). In this pilot non-randomised controlled study, environmental enrichment was provided to one group, and included provision of stimulating equipment on the ward and at the patient bedside, including access to computers, books, newspapers, puzzles, music and board games to promote activity (Janssen et al., 2012). Staff were advised to encourage stroke survivors to utilise these stimulating resources. This study showed promising results. Stroke survivors in the enriched rehabilitation environment were 1.2 times more likely to engage in 'any activity' compared to stroke survivors in a non-enriched rehabilitation environment (Janssen et al., 2014b). 'Any activity' was defined as a stroke survivor performing a physical, social or cognitive activity or any combination of activities in these domains (Janssen et al., 2012). The experimental group were recruited to the enriched environment intervention >14 days post stroke onset and the experimental group was completed within three months, which raised the question of whether an enriched environment can sustain increased activity levels beyond a study period. Interviews with staff working in the enriched environment showed that staff perceived the created enriched environment to promote activity, but they found it challenging to change work routine and implement enrichment strategies within their busy workdays (White et al., 2014). This suggests that the use of change management strategies to support staff to incorporate enrichment strategies needs to be considered, and may be a critical component that supports embedding a complex intervention such as the enriched environment within a complex environment such as the acute stroke unit.

Given stroke survivors are consistently described as inactive and alone in acute stroke units, the acute environment appears to be a critical source of deprivation from sufficient stimulation. Animal models of stroke suggest benefit of exposure to an enriched environment initiated 24-hours post stroke (Johansson & Ohlsson, 1996), and the first clinical translation of an enriched environment in the subacute inpatient setting showed promising results with an increase in activity levels across all activity domains. To maximise recovery, there is a need to utilise the sensitive window of neural repair in the acute phase after stroke, as this sensitive window of restitution of function appears to be in the first 3-months post stroke in humans after which recovery plateaus (Jorgensen et al., 1995; Kwakkel et al., 2006). So, it appears timely to determine the effect of translating an enriched environment to an acute stroke unit, as it is plausible that embedding an enriched environment earlier post stroke could positively influence activity levels, and thereby improve outcomes. Considering that the acute stroke unit is a markedly different clinical setting than the subacute inpatient rehabilitation unit, the model would need to be adapted. In the acute stroke unit, stroke survivors' dependency levels are reported as high as 92% (Nursiswati et al., 2017), and they frequently require assistance in mobility and daily activities (Nursiswati et al.,

2017). In addition, patients require many daily investigations and physical observations, and length of stay is usually shorter in the acute than subacute hospital setting. These characteristics of an acute stroke unit suggest that staff support needs to be an important strategy of embedding an enriched environment model in the acute setting. Thus, the purpose of this thesis was to examine if it is feasible to translate an enriched environment into an acute stroke unit, and to determine the effect of an enriched environment on activity levels in stroke survivors on the acute stroke unit.

1.2 Thesis aims and overview

We will build on the previous enriched environment model used in the subacute inpatient rehabilitation setting to complete a pilot feasibility study in an acute stroke setting. The thesis commences with Chapter 2, which presents a detailed background to the suite of studies that compose this thesis.

Chapter 3 aims to describe the methods used in the before-after pilot study. A study protocol was designed; study design, setting, participants, primary and secondary outcomes including measures, intervention package and fidelity, sample size and statistical analysis were described.

The thesis then outlines four studies described in Chapters 4 to 7. In line with the University of Queensland guidelines, each chapter is designed as a manuscript that stands on its own, thus some repetition may occur across chapters.

In Chapter 4 we aim to determine if an enriched environment embedded in an acute stroke unit increases 'any', physical, social and cognitive activity levels in acute stroke patients compared with usual care. Secondary aims were to determine if an enriched environment improves functional outcomes, reduces adverse events, and shortens length of stay on the acute stroke unit. A controlled before-after observational pilot study was performed. Activity levels were recorded using behavioural mapping of acute stroke patients admitted during an initial usual care period (control group). After the usual care period, an enriched environment intervention was embedded in the same acute stroke unit, and activity levels were determined in acute stroke patients who recovered within an enriched acute stroke unit (enriched group). Differences in functional outcomes, adverse events and length of stay were compared across both groups.

To determine if activity levels of acute stroke patients were sustained 6-months post implementation of an enriched environment in an acute stroke unit, activity levels were recorded in

a third recruited follow up group. The sustainability of an enriched environment on activity levels (‘any’, physical, social and cognitive) in acute stroke patients is presented in chapter 5.

In Chapter 6 we aim to understand how the enriched environment impacted on timing and nature of patient activities, and how much staff assistance was required to facilitate patient activities, across the enriched and control group. Observational data was investigated in more detail, and successful strategies of the enriched environment intervention that increased activity levels at certain time periods, nature of increased activities observed in stroke patients, and how much staff assistance was provided to patients to facilitate activities were described.

To gain further understanding of the mechanisms underpinning observed changes, and the relationship between the components of the intervention and the setting, the experiences and perceptions of staff working in the enriched acute stroke unit were investigated qualitatively. Semi-structured interviews with nursing and allied health professionals were conducted, and exploration of staff experience was supplemented with a staff survey. Further, brief questionnaires were used to probe if patients and carers accepted the enriched environment intervention starting early post stroke. The results of staff interviews, and the surveys conducted with staff, patients and carers are presented in Chapter 7.

Chapters 3,4,5 and 7 contain published work. The chapters have been formatted to create consistency across chapters in the thesis with regards to layout, terminology and reference style. A hyperlink to each publication is included at the beginning of the chapter. Chapter 8 presents the discussion of the thesis highlighting main findings, limitations, strengths and directions for future research. The chapter concludes the thesis and describes clinical implication of the findings and how the enriched environment study in the acute stroke unit impacts on the broader stroke community.

Chapter 2 will explain the need for promoting activity in stroke survivors early after stroke and provides further background to the thesis topic, the enriched environment. It will provide a review of existing literature, identify gaps, and provide the rationale for the studies included in this thesis.

Chapter 2 Background

2.1 Background

2.1.1 Community burden of stroke

In 2013, over 10 million people worldwide experience a new stroke, and 6.5 million people died from stroke (Feigin et al., 2015a). In 2017, nearly 475,000 Australian stroke survivors were living with the effects of stroke (Stroke Foundation, 2017c), from an estimated resident population of more than 24 million (Australian Bureau of Statistics, 2017). It is expected that the number of stroke survivors will rise to 700,000 by 2032 (Stroke Foundation, 2017c). Comparing Australian statistics with comparable countries internationally presents a similar picture. In Canada 400,000 stroke survivors were living with the effects of stroke in 2016 (Heart and Stroke Foundation of Canada, 2017) with a population of more than 35 million (Statistics Canada, 2017). In Canada they also expect a doubling of stroke survivors in the next 20 years (Casaubon, 2015). The United Kingdom had a population of more than 65 million in 2016 (Office for National Statistics, 2017), and more than 1.2 million stroke survivors (Stroke Association, 2017). In the United Kingdom a large increase in stroke survivors to approximately 2.1 million in 2035 is foreseen (Stroke Association, 2017). Worldwide epidemiological trends are demonstrating a consistent picture: a rise in stroke survivors is expected due to the ageing and growing population in the coming years (Feigin et al., 2015b; Giroud et al., 2014).

The Australian Institute and Health Welfare (AIHW) reported over 34,000 of new stroke events in Australia in 2013, with nearly 100 stroke events every day (Australian Institute of Health and Welfare, 2016). In 2012, the health care cost in Australia associated with stroke was $881 million dollars and cost related to reduced productivity after stroke was estimated at $3 billion (Deloitte Access Economics, 2013). Advanced medical procedures such as thrombolysis increase survival rate after stroke, but approximately 45% of thrombolysis patients remain dependent on others in Activities of Daily Living (ADL's). This highlights the need for effective interventions that reduce long-term disability after stroke (Meiner et al., 2010). According to the AIHW 37,000 admissions to hospitals were related to acute stroke in 2013, and length of stay in hospitals for acute stroke care was on average 8 days (Australian Institute of Health and Welfare, 2016). A report in 2000 highlighted that approximately 86% of people who suffer a stroke get hospitalised after their stroke (Thrift et al., 2000). Dedicated acute stroke units have been shown to significantly improve

health-related outcomes after stroke (Mozaffarian et al., 2015; Stroke Unit Trialists' Collaboration, 2013). In 2016, the Stroke Foundation audit showed that across 87% of acute stroke units that provided audit data, 69% of stroke survivors accessed acute stroke units in Australia (Stroke Foundation, 2017b). Maximising access and recovery in the acute phase after stroke has the potential to make a substantial impact on a stroke survivors' functional recovery pathway.

2.1.2 Acute stroke unit care

An acute stroke unit in Australia must meet specific criteria. The Stroke Foundation describes the following minimum criteria: the unit needs to contain co-located beds within a geographically designated ward, with care provided by a multidisciplinary team that has a specialist interest in stroke and rehabilitation (Stroke Foundation, 2015). In addition, the multidisciplinary team is required to meet at least once a week to evaluate patient care, and have a regulated education and training program for staff (Stroke Foundation, 2015). Acute stroke unit services in Australia with >75 stroke patients admitted per year are called Primary Stroke Services. Primary Stroke Services have a designated stroke unit with defined stroke protocols for emergency services, acute care and rehabilitation. In addition, Primary Stroke Services have access to CT brain and angiography, the ability to offer thrombolysis (preferably 24 hours a day, 7 days a week), and protocols to transfer patients to a comprehensive stroke service as required (Stroke Foundation, 2015). Comprehensive Stroke Services are acute stroke units located in large tertiary hospitals with >350 stroke admission per year, and have advanced neurovascular imaging, expert radiology services, and offer thrombolysis and endovascular clot retrieval and neurosurgery (preferably 24 hours a day, 7 days a week) (Stroke Foundation, 2015).

An efficient acute stroke unit is care organised through a coordinated multidisciplinary team who specialises in treating stroke survivors (Stroke Unit Trialists' Collaboration, 2007). Multidisciplinary staffing within the acute stroke unit includes medical and nursing staff, physiotherapists, occupational therapists, speech therapists and social workers (Stroke Unit Trialists' Collaboration, 2007). Each health professional brings their individual expertise and perspective to the team for the benefit of the stroke survivor (Clarke & Forster, 2015). The team will have formal meetings to discuss multidisciplinary assessments, treatments, problem identification, rehabilitation goals and organise discharge needs from hospital for the survivor (Clarke & Forster, 2015). In addition, most multidisciplinary stroke teams have informal meetings with stroke survivors and carers to discuss their stroke care and needs (Langhorne & Legg, 2003).

Evidence has shown that consistency in staff members promotes collective efficacy of a team (Katz-Navon & Erez, 2005). As acute stroke unit care is more efficient with a dedicated multidisciplinary team, it aligns with the evidence that the best outcomes in acute stroke unit care have been found when the stroke unit is based in a dedicated ward compared to a mobile stroke team, which sees stroke survivors located across different wards (Stroke Unit Trialists' Collaboration, 2013).

A systematic review with meta-analysis of 28 trials (n=5855) has shown that stroke survivors who receive care in an organised acute stroke unit compared with a general ward (control) have a reduction in the odds of death or dependency (OR 0.80, 95%CI 0.67 to 0.97), and death or need for institutional care (OR 0.76, 95%CI 0.67 to 0.86) on follow up (average one year post stroke)(Stroke Unit Trialists' Collaboration, 2013). An earlier study investigating acute stroke unit care demonstrated that functional benefits of organised acute stroke unit care persist at 5- and 10-years follow up compared with a control group (Indredavik et al., 1997). Those treated in an acute stroke unit experienced fewer deaths compared to conventional care, and an overall reduction in complications (Stroke Unit Trialists Collaboration, 1997). The difference in complication rates between acute stroke unit care and conventional general ward care largely occurred within the first four weeks after stroke (Govan et al., 2007).

The characteristics of the acute stroke unit that contribute to a reduction in death and disability compared with conventional care are complex. In a systematic review it was demonstrated that the reduction in deaths due to organised acute stroke unit care is associated with reduction in complications and increased use of measures that prevent complications, such as use of oxygen, paracetamol and measures that reduce aspiration (Govan et al., 2007). More recently, a RCT reported a reduction in mortality and disability at 90-days post stroke by 15.7% when an evidence based nurse-led stroke protocol managing fever, hyperglycaemia and swallow dysfunction was implemented on the acute stroke unit (Middleton et al., 2011). Another important factor proposed is that an acute stroke unit reduces deaths due to interventions that reduce the complications of immobility such as ensuring earlier mobilisation. Reducing immobility can lower the frequency of complications such as chest infections, other infections, falls, thromboembolism and pressure sores (Diserens et al., 2012; Govan et al., 2007; Langhorne & Pollock, 2002). An appraisal of stroke rehabilitation evidence performed by the European Stroke Organisation has found that early mobilisation and initiation of rehabilitation were key differences between acute stroke unit care compared with general ward care that contributed to the reduction in complications (Quinn et al., 2009).

At present, there is no clear consensus about the timing of ‘early mobilisation’ after stroke. In the large RCT AVERT (n=2,104), a ‘very early mobilisation intervention (out of bed activities)

group' started mobilisation at a mean of 18-hours post stroke and received a higher dose of mobilisation during the first two weeks post stroke. The early intervention group was compared with a usual care group, who started mobilisation at a mean of 22-hours post stroke and received the usual care dose of mobilisation. In this RCT it was demonstrated that the 'very early mobilisation intervention group' was associated with significantly poorer functional outcomes at 3-months post stroke (AVERT Trial Collaboration group, 2015). Further dose-response analysis of the AVERT data including all study participants showed that when participants were mobilised 'shorter and more frequently' the odds of a favourable functional outcome at 3-months post stroke were increased (Bernhardt et al., 2016b; Langhorne et al., 2017). To understand if the worse outcomes in the AVERT were related to the initial early timing or to the higher dose of mobilisation an observational study compared the relationship between timing of first mobilisation and mortality and quality of life outcomes in a large stroke population in Queensland, Australia (Grimley, 2016). This study used health audit data from the Australian Stroke Clinical Registry (AUSCR) and compared stroke survivors (n=5,337) who were mobilised within 24-hours of admission to hospital with stroke survivors mobilised on the subsequent day. Statistical regression models were adjusted for demographics, stroke severity, previous stroke, acute stroke unit care and stroke type (ischemic vs. haemorrhagic). Results showed that stroke survivors mobilised within 24-hours of admission had improved survival rate and health related quality of life within 6-months post stroke (Grimley, 2016). It needs to be acknowledged that the time stroke survivors present to hospital post stroke varies, indicating that exact time of mobilisation post stroke was unknown. An Australian study reported that 41% of stroke survivors presented within 3-hours and 45% delayed longer than 6-hours post stroke before presenting to hospital (Barr et al., 2006). Taking the above studies together suggests that the higher prolonged dose of mobilisation in the AVERT study was not beneficial early after stroke, but early mobilisation likely is. As a result, the Stroke Foundation Clinical Guidelines for Stroke Management (2017) advise not to start intensive mobilisation within 24-hours post stroke, and recommend short and frequent mobility sessions in the acute stroke setting.

Another important characteristic of acute stroke unit care is early rehabilitation. Rehabilitation is defined as "a process of active change by which a person who has become disabled acquires the knowledge and skills needed for optimum physical, psychological and social function" (Bernhardt et al., 2017). The rehabilitation process starts the first day after stroke and aims to enable the stroke survivor's participation back in the community. The previous paragraph reported on 'early mobilisation' which was defined as 'out of bed activities' after stroke, showing that both concepts are overlapping but separate entities. One of the earliest studies investigating the effect of the important role of early rehabilitation after stroke was completed in a Norwegian acute stroke unit (Indredavik et al., 1999). Critical effective elements highlighted in this study were early

rehabilitation that focused on mobilisation, a team approach, and emphasising patient and family participation (Indredavik et al., 1999). Further rationale for early start of rehabilitation after stroke is provided in the next two sections.

2.1.3 Timing of rehabilitation

There has been considerable variability in how phases of post stroke recovery have been defined in the literature (Bernhardt et al., 2016a). As a result, in this thesis we defined the phases of stroke to align with our patient location (e.g. acute stroke unit). Firstly, the acute phase after stroke reflected the time window from onset of stroke out to approximately 10-14 days post stroke, which coincided with discharge from acute medical services. Secondly, the subacute phase included the time period from14 days till 6 months, coinciding with inpatient and outpatient rehabilitation services. Finally, the chronic phase was defined as beyond 6 months post stroke. Since commencement of this program of studies the Stroke Rehabilitation and Recovery Roundtable (SRRR) Taskforce, an international group of stroke researchers, was developed and worked collectively to achieve consensus around common language and definitions in stroke recovery research (Bernhardt et al., 2017). This group defined a timeline post stroke that reflected important biological recovery processes that occur post stroke. Their timeline defines: 1) a hyperacute phase including the first 24 hours post stroke; 2) an acute phase from 1-7 days post stroke; 3) an early subacute phase from 7 days till 3 months; 4) a late subacute phase 3 till 6 months, and 5) a chronic phase beyond >6 months post stroke. This common language was urgently needed and will be critically important to align the field. However, given it was only recently published (2017), the timeline proposed for this thesis may deviate from the timeline recently defined by the SRRR Taskforce.

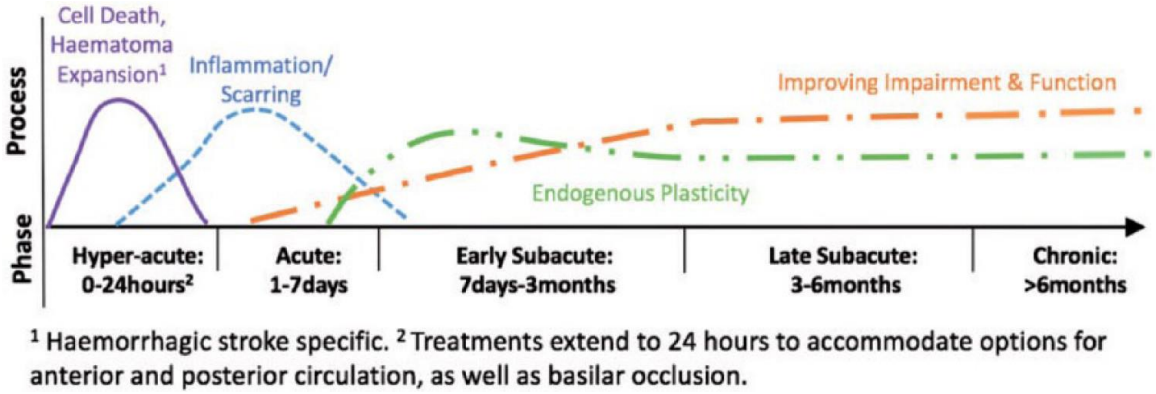

Figure 2-1 Framework that encapsulates definitions of critical time-points post stroke that link to the currently known biology of recovery

Reproduced from Bernhardt et al., 'Agreed definitions and shared vision for new standards in stroke recovery research: The Stroke Recovery and Rehabilitation Roundtable Taskforce' Neurorehabilitation and Neural Repair (2017)

Irrespective of the definition, the acute, and early subacute phases after stroke are a sensitive time window for brain repair and neural plasticity (Krakauer et al., 2012; Ward, 2017). In preclinical (animal) studies the time window for heightened plasticity after focal brain injury has been found to be highest in the first 4-weeks after stroke (Biernaskie et al., 2004), with a large proportion of recovery attributable to spontaneous recovery (Jeffers et al., 2018). First evidence of the sensitive window was found when rodents who commenced enriched rehabilitation 30-days post focal brain injury made little gains in motor recovery, while enriched rehabilitation that was initiated 5-days post stroke resulted in significantly improved motor recovery (Biernaskie et al., 2004). Animal models of stroke have shown that intense motor training starting in the sensitive time window for brain repair has maximum effect (Biernaskie et al., 2004), and that delayed initiation of motor training out to 7-days post stroke resulted in incomplete recovery in rodents (Zeiler et al., 2016). Importantly, intense motor training starting 5-days post injury did not exacerbate infarct size (Biernaskie et al., 2004). An increase in infarct size was found in a study where intense motor training was commenced 24-hours after injury, which raised concerns of starting intense training too early (Risedal et al., 1999). The first 3-days after brain injury shows cells surrounding the infarct area that are hyper-excitable, and it is hypothesised that commencing intense motor training too early may cause death within this collection of cells, resulting in an exacerbation of infarct size (Biernaskie et al., 2004; Ward, 2017). Taken together, preclinical models show a sensitive time period for brain repair in the first 4-weeks after focal injury where intense motor training has maximum effect when commenced at ~5 days post stroke.

In human stroke survivors a similar window of unique heightened recovery that supports biological restoration of function was found, with recovery of motor function achieving stability after 3 to 6 months post stroke (Jorgensen et al., 1995; Kwakkel et al., 2006). In addition to motor recovery, a window of heightened recovery has also been reported to exist for language and visuospatial neglect restoration (Lendrem & Lincoln, 1985; Winters et al., 2017). Again, similar to animals, a large proportion of recovery occurs in humans in this time window (Winters et al., 2015, 2017). The presence of a sensitive window for brain repair in humans advocates for delivery of intense training efforts to augment plasticity to achieve maximum recovery early. However, translation in human models has been challenging. There is an urgent need to understand biological restoration processes after stroke in human models and how rehabilitation can affect these biological restoration processes. Taken together, the consensus in human models of stroke appears to be that rehabilitation should be started early after stroke in an acute stroke unit and gradually build up in intensity during the first 5-days post stroke, after which intense training should be commenced to enable effective utilisation of the sensitive window for brain repair (Krakauer et al., 2012).

2.1.4 Early rehabilitation after stroke

Consequences after stroke can include difficulties with motor function (such as walking, arm and hand function), speech and language, fatigue, depression and anxiety, memory and thinking: all of which can have a huge impact on the stroke survivor's everyday activities of living, community participation, and quality of life. A survey with stroke survivors living in the community showed that greater disability, younger age, fatigue and cognitive problems were particularly associated with unmet health needs (Andrew et al., 2014).

Motor impairment is commonly reported after stroke; 80% of stroke survivors have reduced motor control in the face, arm or leg, which makes recovery of motor function an important goal for stroke survivors (Langhorne et al., 2009). A systematic review and meta-analysis regarding the evidence for physical therapy after stroke implies that there is strong evidence for positive effects of interventions that target gait, arm/hand activities and physical fitness in the acute and subacute phase (Veerbeek et al., 2014). A high dose of repetitive task-specific training was found to be a key factor in meaningful practice after stroke, and that a higher amount of practice promotes better restoration of motor function and daily activities (Veerbeek et al., 2014). Another systematic review that compared studies with the same type of intervention at different amounts of delivered therapy, showed that increasing the amount of therapy improved activity outcomes of stroke survivors

(Schneider et al., 2016). Furthermore, it showed that to achieve these better outcomes a large 240% increase in therapy amount was required (Schneider et al., 2016). Thus, the consensus is that in the first week after stroke physical training should target gait and arm/hand function, and substantial opportunities should be provided to undertake these activities (Krakauer et al., 2012).

While the majority of evidence regarding effects of rehabilitation after stroke involves recovery of motor function, other functions are important to the stroke survivor and require considerable rehabilitation input. Approximately 30% of stroke survivors experience aphasia after stroke (Worrall & Foster, 2017). Stroke survivors with aphasia experience difficulties in one or more of the following language areas: speaking, comprehension, reading and writing. Aphasia has an enormous impact on many daily activities and results in a reduced quality of life (Hilari et al., 2012). A systematic review (n=27 studies with participants recruited across acute, subacute and chronic phase) showed that speech and language therapy including functional use of language such as speaking, reading, listening and writing benefits recovery of language when compared to no therapy (Brady et al., 2016). Furthermore, patients with aphasia that received higher intensity of individualised language therapy over a longer duration period had significantly reduced aphasia severity (Brady et al., 2016). A recent high quality RCT (n=156) found that 3-weeks of intensive speech therapy (≥10 hours per week) in stroke survivors with chronic aphasia (> 6-months post stroke) significantly enhanced verbal communication when compared with a group where speech therapy was deferred (Breitenstein et al., 2017). There is at present a large ongoing trial to determine the effect of intense speech therapy that starts very early after stroke (Godecke et al., 2016). Australian Clinical Guidelines for Stroke Management (2017) recommend that language treatment should be provided as early as tolerated and that intensive language therapy may be used to aphasia patients.

Post stroke depression and anxiety occur frequently in the first year after stroke. Depression affects approximately 33% of stroke survivors at any one time after stroke (Towfighi et al., 2017), and anxiety has been found in 25% of stroke survivors spanning the acute phase till 5 years post stroke (Campbell Burton et al., 2013; Chun et al., 2018). Depression can affect stroke survivors early after stroke with 5%-54% experiencing depression in the first month after stroke (Kouwenhoven et al., 2011). Stroke severity, history of depression, physical disability and cognitive impairment have been consistently shown to be predictors of depression, and are associated with reduced quality of life after stroke (Towfighi et al., 2017). Less specific knowledge is available regarding anxiety after stroke, but anxiety negatively impacts on rehabilitation and quality of life (Chun et al., 2018). Australian Clinical Guidelines for Stroke Management (2017) recommend that stroke survivors with suspected depression should be assessed using validated measures, while

insufficient evidence is available to support a specific recommendation for post stroke anxiety. The Diagnostic and Statistical Manual of Mental Disorders (DSM-IV) is recommended for diagnosis of anxiety.

Over 60% of stroke survivors have cognitive or perception deficits on admission to rehabilitation, which include executive functions, attention, memory, orientation, apraxia and agnosia (Nys et al., 2007; Stroke Foundation, 2016). Cognitive disorders are determinants for dependence in basic and more complex functional activities after stroke (Nys et al., 2007). There is currently limited evidence for cognitive rehabilitation after stroke. A randomised controlled trial that investigated early (recruitment within 4 weeks of stroke onset) and intense (16 one hour sessions over 4 weeks) cognitive training made significant improvements in cognitive outcomes compared with a control group who received a sham intervention (Zucchella et al., 2014). Cognitive strategy training when initiated early after stroke has shown promising results in achieving improved functional independence, but participant numbers in this study were small (n=15) (Skidmore et al., 2015). While this intervention requires further investigation, it encompassed the stroke survivor's ability to observe, assess and change their own behaviour, and to generate strategies to encounter difficulties in real life situations (Skidmore et al., 2015). Looking into the field of traumatic brain injury, a recent systematic review (n=9) investigating cognitive rehabilitation showed insufficient evidence to support cognitive rehabilitation (Kumar et al., 2017). Taken together, limited evidence is currently available for cognitive rehabilitation and required amount of practice after stroke. The Australian Clinical Guidelines for Stroke Management (2017) provides a weak recommendation that cognitive strategy and rehabilitation may be provided after stroke on the basis of limited high quality data. Despite this, it is recognised that cognitive deficits are prevalent, impact highly on daily activities, and are associated with needs not met after stroke (Andrew et al., 2014).

Evidence for acute stroke unit care and early rehabilitation across the Australian, United Kingdom and Canadian Stroke evidence based Clinical Practice Guidelines inform recommendations that early and active rehabilitation by a dedicated stroke team should be offered to stroke survivors (Heart and Stroke Foundation of Canada, 2016; Stroke Foundation, 2017a) (Royal College of Physicians, 2016). Box 1 outlines key recommendations for mobilisation and rehabilitation from the most recently released guidelines, the Australian Clinical Guidelines for Stroke Management (2017).

Box 1. Australian Clinical Guidelines for Stroke Management (2017) key recommendations for mobilisation and early rehabilitation.
1. Patients should not be mobilised intensively during the first 24-hours after stroke. 2. Patients should receive physiotherapy and occupational therapy as frequently as possible but at least two hours during 5-days a week. 3. Upper limb training should start early and requires as much tailored practice as possible. 4. The use of circuit training is advised to increase intensity of practice to improve walking ability. 5. In patients with communication/ aphasia difficulties the guidelines recommend to start therapy as early as tolerated, and intensive aphasia therapy may be used. 6. For stroke patients with cognitive impairments, strategy and cognitive rehabilitation may be provided.

To achieve the amount of practice stated in the key recommendations, the Clinical Guidelines recommend involving non-therapy staff, family and friends to encourage the stroke survivor to practice exercises and skills outside therapy hours. Taken together, providing sufficient opportunities for stroke survivors to practice meaningful activities in the acute phase after stroke has the potential to maximise recovery.

2.1.5 Measuring activity after stroke

Activity in stroke survivors has been measured in different phases after stroke recovery, in different health care settings and using a variety of methods. The most frequent methods used to quantify the activity of stroke survivors involve the use of activity monitors, questionnaires and behavioural mapping (Fini et al., 2017). Activity monitors are devices that can be worn 24-hours of the day, and provide continuous recordings of the amount of physical activity undertaken. Outputs include number of steps taken, acceleration or amplitude of upper limb movement, or changes in posture such as sitting to standing. Accelerometers are a type of activity monitor that measures movements in one, two or three directions during moments of acceleration and multi-axial devices provide accurate levels of activity in healthy subjects (Van Remoortel et al., 2012). Yet, there are some limitations to the use of accelerometers. Activity monitors have shown to be less accurate in counting steps when subjects demonstrate slow walking speeds (Van Remoortel et al., 2012). Another disadvantage of accelerometers is the inability of the device to distinguish between

measuring purposeful movement and non-purposeful movement, or if movement is actively or passively generated (Hayward et al., 2015; Mattlage et al., 2015). Furthermore, monitors are unable to detect if the performed physical activity was related to therapy or was self-initiated by the stroke survivor. Importantly, accelerometers fail to capture other types of activity such as social and cognitive activity.

Questionnaires are a cheaper method, which include diaries, interviews and activity recall questionnaires. Questionnaires have the advantage that they can be used in large populations (Westerterp, 2009). However, in observational research these methods have shown low reliability and validity for measuring physical activity (Westerterp, 2009). This approach also requires communication and cognitive skills that are deficient in many acute stroke survivors. Another method mentioned in the literature is video recording physical activity. This method has been previously used to primarily assess a clinician's accuracy in estimating patients' physical activity during therapy time, as it is known that clinicians overestimate activity levels (Kaur et al., 2013). Using videorecording as a tool to observe physical, social and cognitive activity in patients is extremely time consuming. Furthermore, ethical and privacy legislation constraints make research using these techniques problematic, including dealing with recording of visitors and staff interacting with research participants.

Behavioural mapping is a method using direct observation to estimate how much activity individuals are undertaking during a certain period of time. Patients are observed at a certain time interval e.g. one minute of every 10-minutes, and during each interval the observed activity is recorded. The method has demonstrated good interobserver reliability for physical activity, location and people present in stroke survivors within an acute stroke unit: weighted Kappa score < 0.67 (range 0.67 - 1.00) showing close association (Bernhardt et al., 2004). No reports were found for validity of behavioural mapping by the author. Disadvantages of the behavioural mapping method are that the large number of observations are time consuming (Mattlage et al., 2015; Westerterp, 2009), and that physical activities that occur outside the direct observation time are not captured, as opposed to monitor devices that allow for continuous measurement (Mattlage et al., 2015). A great advantage of behavioural mapping is that in addition to physical activity, social and cognitive activity, posture, location and people present with the stroke survivor can be recorded, which adds a contextual dimension to the activity measurement (Janssen et al., 2012; Westerterp, 2009). Furthermore, direct observation of activities allows identification whether the activity performed is active, passive or a purposeful activity. In behavioural mapping, trained researchers observe and record the required information, using defined checklists that contain predetermined categories specified to the unique context (Janssen et al., 2012). Behavioural mapping is ideal to measure

change in physical, social and cognitive activity levels after stroke in the acute setting. Taken together, the choice of method for quantifying activity levels in stroke survivors depends on the type of activity under investigation and whether additional contextual information is important to be captured related to the specific study aims. To capture physical, social and cognitive activity domains simultaneously and accurately, behavioural mapping is the best instrument of choice.

2.1.6 Activity levels after stroke

Early, frequent rehabilitation (including mobilisation) after stroke with an emphasis on large amounts of practice for physical activities and communication promotes recovery after stroke. Physical activity has been defined as 'everyday personal, athletic, recreational or occupational activities that require physical skills and utilise strength, power, endurance, speed, flexibility, range of motion or agility (Janssen et al., 2012). It is concerning that a large group of studies has consistently demonstrated that stroke survivors recovering from stroke spend a large amount of time inactive and alone in the acute stroke unit with the most severely affected stroke survivors spending more time of the day being inactive (Bernhardt et al., 2004; Fini et al., 2017; Kramer et al., 2013; Mattlage et al., 2015; West & Bernhardt, 2012). In the early phase after stroke it was demonstrated that stroke survivors, who were observed from 8am till 5pm in the acute stroke unit, spend more than 50% of their time in bed and were alone for more than 60% of their day (Bernhardt et al., 2004). Furthermore, only 13% of their day was spent on highly therapeutic activities such as sitting unsupported, standing and walking (Bernhardt et al., 2004). A systematic review in 2012 investigating activity levels in hospitalised stroke survivors showed that activity levels in stroke survivors were found to be similar to a study nearly a decade earlier (2004) (West & Bernhardt, 2012). Stroke survivors were found to be inactive around 48% of the time, and alone for 53% of the day, with low physical activity levels across the first 14-days post stroke (West & Bernhardt, 2012). This systematic review included prospective studies that used behavioural mapping, video recording or therapist reports for data collection. Another study, which used accelerometers to determine sedentary time found that acute stroke survivors spent on average 81% of their time sedentary (Tieges et al., 2015). Sedentary behaviour is a term used for activities that require low levels of energy such as sitting or lying in bed (Tieges et al., 2015). Physical activity levels remain low in the acute phase, with a recent systematic review published in 2017 showing that stroke survivors spend approximately 45% of their time in bed (Fini et al., 2017). Clinicians working in acute stroke units have been made increasingly aware of low physical activity levels after stroke, as the previous Australian stroke guideline recommended to promote physical activity 'as much as possible' to

enhance recovery (Stroke Foundation, 2010). This suggests that it is difficult for clinicians to achieve higher physical activity levels in acute stroke units, and that there is a need for innovative ways to increase physical activity levels.

Australian Clinical Guidelines for Stroke Management (2017) recommend commencing speech and language therapy, and cognitive rehabilitation in the acute phase. To date, only a few studies have investigated the amount of social and cognitive activity performed after stroke. A study performed across four rehabilitation centres in Sweden measured physical activity and social interaction in stroke survivors (median time since stroke 19 days) (Skarin et al., 2013). Social interaction was estimated using direct observation of people who were present with the stroke survivor, and more than one person could be present with the stroke survivor at the same time. Results showed that stroke survivors were with therapists (17%), other patients (16%) nursing staff (13%) and with family (9.3%) of the time. However, the majority of time (52%) stroke survivors were on their own (Skarin et al., 2013). A further study estimated social and cognitive activity levels in the subacute inpatient rehabilitation setting. In this study behavioural mapping was expanded to include social and cognitive activity definitions with predefined checklists of activities categorised in these domains (Janssen et al., 2014b). Classification of "activity" required observation of active engagement in a social or cognitive activity. Stroke survivors were observed for 12-hours during a week and weekend day. Stroke survivors were engaged in a social activity for 32% of the time, and in cognitive activity for only 4% (Janssen et al., 2014b). Thus, the few studies that have investigated social and cognitive interactions in stroke survivors in the subacute phase indicate that they spend little time in these activities during waking hours.

Several studies have compared activity levels on weekdays to weekend days in the subacute inpatient rehabilitation setting. Stroke survivors undertake lower levels of physical activity during weekend days compared with weekdays. In a study published in 1996, time spent on motor activity was compared between weekday and weekend days in two subacute inpatient rehabilitation units (Mackey et al., 1996). The authors showed that stroke survivors were spending significantly less time on task practice during weekends (7% vs. 14% of their waking hours) (Mackey et al., 1996). Similar low activity outcomes were observed in an Australian subacute inpatient rehabilitation unit in 2011. In this stroke unit, stroke survivors performed therapeutic activities for only 5% of waking hours on a weekend day compared with 15% on a weekday (King et al., 2011). Furthermore, stroke survivors were observed on weekends to spent 97% of their time in their bedroom compared to 76% on a weekday (King et al., 2011). Only one study has compared physical, social and cognitive activity levels across week and weekend days, and found that physical activity levels were 5%

lower on weekends, with no difference found for social and cognitive activity (Janssen et al., 2014a).

Limited literature is available regarding activity levels on weekend days in an acute stroke unit. It is hypothesised that activity levels during weekend days would be even lower than weekdays in an acute stroke unit due to reduced nursing staff levels on weekend days and input from allied health professionals not being standard practice over weekend days (Otterman et al., 2012). It is important to consider the lower activity levels during weekend days with regards to the risk of complications caused by immobility, and the reduced opportunity to utilise the critical time period of plasticity after stroke. Therefore, establishing an environment that would increase activity levels in the acute stroke unit on all days, including higher activity levels outside therapy hours has the potential for significant positive impact on recovery after stroke.

Increased activity early after stroke has shown to promote recovery. This raises the question if all stroke survivors can engage in greater activity early after stroke. A variety of factors can influence activity levels and the resulting recovery of function after stroke. Pre-stroke disability has been shown to impact on the stroke survivors' ability to engage in activity after stroke, as well as to impact on prognosis after stroke (Quinn et al., 2017). Pre-stroke disability in stroke research is mostly expressed using the premorbid modified Rankin Scale (mRS), which is a robust predictor of prognosis after stroke (Quinn et al., 2017). Other factors related to reduced recovery after stroke include age and stroke severity, which are independently correlated to negatively affect recovery post stroke (Meyer et al., 2015). The National Institute of Health Stroke Scale (NIHSS) is a reliable tool to quantify the level of stroke severity weighted on assessment findings (Goldstein & Samsa, 1997). In addition, greater stroke severity has also shown to impact on activity levels early after stroke, which are generally lower with higher stroke severity (Bernhardt et al., 2004). Factors that impact on activity and recovery after stroke need to be considered when investigating interventions that aim to increase activity levels in stroke survivors.

2.1.7 Interventions to increase activity

One-on-one treatment by therapists is not always feasible after stroke and is costly. The Dutch stroke clinical guidelines recommended in 2009 that stroke survivors should receive a minimum of 2 sessions of 20-30 minutes of physical exercise per workday. A survey amongst physiotherapists working in 91 acute stroke units in the Netherlands showed that 67 acute stroke units did not have a protocol in place prescribing the amount of time spent on physical exercise per day (Otterman et al.,

2012). Furthermore, physiotherapists participating in the survey estimated that on average only 22-minutes of therapy was provided during weekdays and that intensity of practice was not optimal in an acute stroke unit (Otterman et al., 2012). Possible alternatives mentioned to augment time spend on physical exercise included an increase in funding to employ more therapists, provide group training, introduce weekend services, increase family involvement, utilise allied health assistants (AHA) and utilise modes of practice such as robotics (Otterman et al., 2012). An Australian study observing therapy time provided by the multidisciplinary team members within five acute stroke units who were resourced to recommended levels, revealed that on average 24-minutes of physiotherapy, 23-minutes of occupational therapy and 33-minutes of speech therapy was delivered with only 17% of stroke survivors receiving therapy from more than one therapist daily (Bernhardt et al., 2007). Thus, the amount of therapy provided by health professionals in the acute stroke unit overall is low. As a result, alternative methods to achieve sufficient intensity of rehabilitation have been recognised as a major goal for stroke recovery.

Other alternatives are available to increase activity levels in stroke survivors. Circuit class training provided to stroke survivors in subacute inpatient rehabilitation or community settings has shown moderate evidence to improve mobility after stroke (English et al., 2017). Circuit class training provides stroke survivors the opportunity to practice tasks within a supervised group setting, which enables stroke survivors to increase practise time. A Cochrane review (2017) showed that stroke survivors who had participated in circuit class training were able to walk faster, further and more independently, when compared with conventional physiotherapy (English et al., 2017). Another study, which introduced group therapy sessions during subacute inpatient rehabilitation demonstrated that group therapy increased time spent in therapy, as well as time spent in social interaction with other stroke survivors (De Weerdt et al., 2001). Social and cognitive stimulation, in addition to physical goals was also emphasised in the Fitness and Mobility Exercise (FAME) group training, a training program undertaken in community settings, which also demonstrated beneficial effects across physical outcomes (Eng, 2010). There is very limited evidence that group therapy or circuit class training has been investigated within an acute stroke unit setting to determine its effect on increasing activity levels and recovery. A plausible reason for this is that stroke survivors in acute stroke units have a shorter length of stay, are more dependent in mobility than compared with the subacute phase, and design and resources may prevent inclusion e.g. access to a sizeable therapy room.

Another opportunity to increase activity levels after stroke is utilising therapy or generic rehabilitation assistants. Allied Health (therapy) assistants are trained to assist physiotherapists or occupational therapists, while generic rehabilitation assistants have been described in the literature

as assistants who provide support to all members of the multidisciplinary team including physiotherapists, occupational therapists, speech and language therapists and nurses (Lockhart et al., 2006). AHAs in most countries work under the appropriate guidance and supervision of the respective allied health therapists to ensure safe work practice (Occupational Therapy Australia, 2015). Health care cost related to stroke are expected to rise in the future (Australian Institute of Health and Welfare, 2013), suggesting that flexibility and creativity in staffing might be another opportunity to increase activity levels after stroke and enable high quality models of care (State Government of Victoria, 2012). According to the Bureau of Labour Statistics in the United States, physical therapy and occupational therapy assistants are amongst the fastest growing occupation (Hsieh et al., 2010). Utilising AHAs might be a cost effective way to ensure increased intensity of exercise therapy and rehabilitation after stroke. A study exploring the use of AHAs showed that AHAs made a substantial contribution to the total delivered therapy to stroke survivors within a subacute inpatient rehabilitation setting (Hsieh et al., 2010). The National Health Strategy Improvement Stroke project in the United Kingdom explored different ways to increase daily therapy to stroke survivors. One example incorporated to increase exercise was the increased use of AHAs, which demonstrated a successful rise in therapy activity time (Lockhart et al., 2006). There is limited evidence available from research studies as to how AHAs are utilised within an acute hospital setting. Government reports show that AHAs are usually discipline-specific in the acute hospital setting and work across a variety of disciplines in rehabilitation settings in Australia (Government of Western Australia, 2015; New South Wales Government, 2015). Utilising AHAs in a creative way across a variety of disciplines in the acute stroke unit is worth considering, as AHAs have been found to increase therapy time after stroke in subacute inpatient rehabilitation.

As previously mentioned, the amount of physical activity observed in stroke survivors was significantly lower on weekend days. Providing therapy on weekend or during after-hours is an opportunity to increase amount of rehabilitation. Studies have shown that providing additional therapy to stroke survivors during the weekend resulted in improved functional outcomes (Caruana et al., 2017; Kinoshita et al., 2017; Peiris et al., 2013). A small systematic review (n=7 studies) exploring the effect of after-hours rehabilitation (therapy provided on evenings and/ or weekends) showed that additional therapy during after-hours resulted in higher physical activity levels and may improve activities of daily function (Scrivener et al., 2015). However, providing therapy during after-hours and weekends involves additional staffing cost in Australia, as evening or weekend shift allowance makes staffing expenditure expensive. Alternative approaches to increase physical activity by changing staff roles e.g. nursing led exercise groups on weekends are being investigated and appear feasible (Scrivener et al., 2017).

To increase efficacy in rehabilitation and to increase the amount of time spent on activities, stroke survivors themselves can play an important role in driving their own recovery outside of therapy hours. A qualitative study investigating factors affecting the stroke survivor's ability to drive their own recovery during inpatient rehabilitation showed that stroke survivors wanted the ability to continue to practice learned tasks during rehabilitation outside therapy hours (Eng et al., 2014). They perceived a lot of time outside of therapy was wasted. Factors limiting stroke survivors to practice was the time stroke survivors attributed to dealing with loss, which impacted on their ability to support their own recovery. In comparison, stroke survivors expressed that 'hope and motivation' positively impacted on their ability to support their own recovery. They perceived positive staff attitudes and staff that provided positive feedback on stroke survivors' progress as highly motivating. Stroke survivors also indicated that few opportunities to be active were available, and they indicated that they would like the unit to organise a variety of group activities or that more equipment was made available to practice outside of therapy hours (Eng et al., 2014). This study recommended that stroke survivors require opportunities and encouragement to continue their practice independently, and that an enriched environment may be used to create a stimulating environment (Eng et al., 2014).

An innovative self-administered program of independent practice, the Graded Repetitive Arm Supplementary Program (GRASP) has been developed to assist stroke survivors to independently practice practical upper limb activities (Harris et al., 2009). A trial of the GRASP for 4-weeks in the early subacute phase showed that stroke survivors in the GRASP group had greater improvement in upper limb function as compared to usual rehabilitation care (Harris et al., 2009). GRASP is a program instructed once by a health professional and then afterwards can be undertaken independently or with support of a family member. In addition, stroke survivors have reported high satisfaction with the GRASP (Harris et al., 2009). Integrating principles similar as GRASP where stroke survivors can independently practice meaningful activities may increase activity levels in an acute stroke unit

Use of interactive technology such as iPads/ tablets is growing as it allows stroke survivors to increase variety and intensity of therapy. One study examined the feasibility of tablet use to increase communication therapy in stroke survivors with communication deficits in the acute stroke setting (Mallet et al., 2016). Stroke survivors received 15-minutes instructions on day one, and 10-minutes follow up instruction on day two from a speech therapist. Commercial apps were used in this study to increase communication rehabilitation by one-hour a day. Results showed that 83% of stroke survivors completed the one-hour a day of practice (Mallet et al., 2016), but the effect on function is not yet known. A study investigating stroke survivors' perspective of tablet use in the subacute

inpatient setting demonstrated that tablet use became easier over time after initial challenges, and was perceived as stimulating (White et al., 2015a).

Self-management is an alternative approach to enable stroke survivors to support their own recovery. Self-management involves the stroke survivor, family and clinicians to collaborate to increase the stroke survivor's ability to manage his own condition (Preston et al., 2017). Self-management programs for stroke survivors include education about stroke and provide stroke survivors with skill training and encouragement to take ownership in their own recovery (Fryer et al., 2016). A systematic review of self- management programs (n=14 RCT's) delivered in the community have shown to improve quality of life and self-efficacy for e.g. reduced alcohol intake and smoking, improved diet in stroke survivors living in the community, but no superior effect in activities of daily living and participation has been found (Fryer et al., 2016). Limited evidence is available for the application of self-management in the acute stroke unit (Fryer et al., 2016).

The involvement of the caregiver and relatives in the rehabilitation process can increase intensity of practice and improve stroke survivors' outcomes (Galvin et al., 2011). Furthermore, family members have indicated that they are prepared to deliver additional therapy (Galvin et al., 2009). In the FAME (FAmily Mediated Exercise) study, an additional daily 35-minutes of individualised family mediated exercise with a nominated family member occurred in the subacute inpatient rehabilitation setting. Stroke survivors showed significant improvements in activities such as walking and activities of daily living, better community integration and reduced caregiver strain at 3-months follow up with family member exercise (Galvin et al., 2011). The study used tailored individual exercise programs and compliance was documented in an exercise diary. In the GRASP study, a regression model showed that caregiver involvement contributed to 5% to 9% greater upper limb improvement when compared with a group without caregiver support (Harris et al., 2010). This study also found that stroke survivors with caregiver support were more likely to spend time exercising during the day, which resulted in increased intensity of upper limb training (Harris et al., 2010). A recent published study investigated an 8-week caregiver-mediated exercise program commencing in the acute hospital (van den Berg et al., 2016). The stroke survivor and caregiver were provided with a set of exercises for 8-weeks targeting gait and gait related activities and were encouraged to exercise five times a week for 30-minutes. The program continued after stroke survivors were discharged home and was supported by tele-rehabilitation to allow for access to therapists and through a weekly home visit. The study demonstrated that on average 2-hours of extra exercise per week was performed, a trend towards improved mobility function was shown, and caregivers reported higher self-efficacy (van den Berg et al., 2016). The results of the reported

studies suggest that family involvement can contribute to an additional amount of extra activity, and improved satisfaction after stroke.

2.1.8 Consumer experience of rehabilitation

The consumer experience of physical rehabilitation has been investigated in a systematic review spanning the acute and subacute inpatient setting including 31 studies (Luker et al., 2015). Synthesising perspectives and preferences of stroke survivors while staying within acute and subacute inpatient settings showed that stroke survivors highly valued physical activity and stroke survivors believed that more physical activity was better for their recovery (Luker et al., 2015). Stroke survivors expressed they felt bored and alone during their inpatient stay, and that boredom and insufficient stimulation had a negative effect on their mood and motivation. Furthermore, stroke survivors reported they wanted to practice meaningful activities, and the importance of walking and mobility therapy was emphasised across the acute and subacute phase. In addition to therapy, stroke survivors wanted more access to recreational opportunities to reduce loneliness while staying in the acute and subacute inpatient settings (Luker et al., 2015). Recreational activities included games, reading materials and social opportunities with staff, family and other patients. Boredom has been further highlighted to negatively impact on the stroke survivors' engagement in inpatient rehabilitation in a scoping review including 24 studies. In inpatients with acquired brain injuries (ABI), boredom was a very common experience and contributed to the patients' feeling of lack of control (Kenah et al., 2017). Contributing factors to feeling bored were personal factors such as lack of motivation and limited physical independence and environmental factors including the physical environment and organisational structure of the rehabilitation unit. In this work, patients with ABI indicated that communal areas and outdoor spaces reduced boredom as they provided opportunities for engagement in activities (Kenah et al., 2017). Taken together, consumers expressed their need for more opportunities to be active, wanting meaningful activities, a stimulating physical environment, and a rehabilitation culture that encourage stroke survivor activity and autonomy in the acute and subacute inpatient setting.

2.1.9 Effect of the physical built environment on activity

The effect of the physical environment on recovery and wellbeing within a health care facility has received more attention over the last decade, as the environment has proven to be relevant for

patients, carers and staff. In 1984, a study demonstrated that cholecystectomy patients who had a nature view from their room had reduced length of stay and use of analgesics when compared with cholecystectomy patients who viewed a brick wall (Ulrich, 1984). Healing environments have been defined as a place where patient and staff interaction within a physical environment results in positive health outcomes (Huisman et al., 2012). Current evidence recommends that features such as single rooms, lighting, enhancing control for patients, privacy and comfort are important to improve safety and wellbeing in patients (Huisman et al., 2012). The In2Health design model published in 2014, explains a framework of building design within the International Classification of Functioning, Disability and Health (ICF). Within this framework the physical built health care environment is seen as an environmental factor that impacts at the patient level, and can influence physical fitness, cognition and wellbeing (van Hoof et al., 2015). This framework supports that physical design features may need to be different for specific patient groups. A recent study observed stroke survivors in a Swedish acute stroke unit pre and post rebuilding of the unit, and highlighted how location of the communal area and bed lay out (single vs. multi-room) influenced activity levels of stroke survivors, and their ability to optimally engage with the environment (Anaker et al., 2017). Findings indicated that in the new acute stroke unit, stroke survivors spent more time alone, in their rooms, and were less active compared with stroke survivors who recovered in the original 'old' unit (Anaker et al., 2017). While there is a push towards single bed spaces for reasons such as infection control and privacy, the possible impact of single rooms on stroke recovery, activity levels and interaction with others needs to be seriously considered (Pennington & Isles, 2013). A survey in Scottish adults (n=990) showed that 41% of adults preferred a single room in hospital wanting privacy, while 25% indicated preference for a multi-bedroom placing an emphasis on company, and 27% of respondents reported no preference (Scottisch Government, 2008). The studies indicate that future research should focus on the effect of the physical built environment of an acute stroke unit on the stroke survivor's activity and wellbeing, and how an optimal healing environment can be created that supports recovery after stroke.

One study in a comprehensive stroke unit in Norway included the environment of the acute stroke unit as a strategy to facilitate stroke survivors' activity (Askim et al., 2012). In this unit stroke survivors were encouraged to spend time in communal ward environments and to consume meals in communal areas. In addition, this unit used a philosophy of close collaboration between nursing and allied health staff to increase stroke survivors' activity and emphasised mobilisation, early rehabilitation and independence in activities of daily living. Observation of stroke survivors (n=124 included, n=106 analysed) over an 18-month period showed that stroke survivors in this unit were in bed only 30% of the time between 8am and 5pm, and spent nearly 20% of their time on

higher motor activities such as transfers, standing and walking (Askim et al., 2012). Teamwork and creative use of the environment were contributing factors to increased physical activity levels. As it is not always possible to provide high intensity of meaningful practice through therapist-led treatments, utilising the environment could help increase activity levels by providing a stimulating 'enriched environment', enabling the stroke survivor to be physically active during the day and during non-formal rehabilitation time in an acute stroke unit.

2.1.10 Enriched Environment

The enriched environment design has been well investigated in animal models of several different neurological disorders, including rodents with a stroke, and is showing promising results with regards to stroke recovery. The concept of an enriched environment was first studied in 1949 by Donald Hebb in a preclinical (animal) model (Hebb, 1949). He investigated the impact of the environment on memory and learning and compared the learning abilities of rats housed in isolation to rats with access to unlimited environmental stimulation in his own house. Rats in the 'enriched environment' performed superiorly in problem solving when compared to those in isolation (Kobayashi et al., 2002). The principles of environmental enrichment as embedded by Donald Hebb were further developed creating the treating paradigm and model known today as 'enriched environment' (Rosenzweig et al., 1962). An enriched environment was originally used to describe housing conditions that provide opportunities for social stimulation (Rosenzweig et al., 1962). In laboratory settings standard housing (two or three animals per cage) nowadays refers to conditions that offer free access to food, water and nesting for the animals (mostly rodents) in a small cage with no further contents. In comparison, the enriched environment cage contain 8-12 rodents, are larger in size, and are filled with a variety of objects and toys that are periodically changed to keep the environment novel (see figure 2.1) (Hannan, 2014; Nithianantharajah & Hannan, 2006).

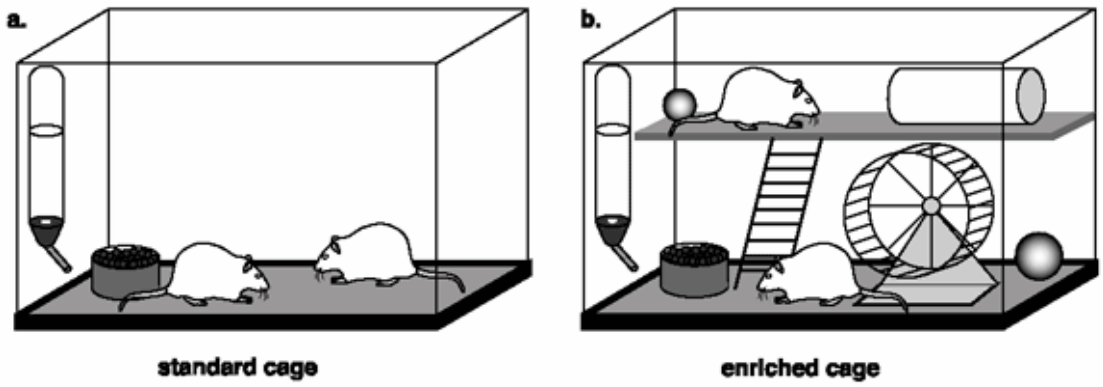

Figure 2-2 Standard cage versus enriched environment cage

Rodents who live in enriched conditions voluntarily engage in social interaction and objects within the cage 24-hours a day and are not forced in any particular task (Johansson & Ohlsson, 1996; Sale et al., 2009). The enriched environment model aims to provide physical, social and cognitive stimulation to the rodents. Sensorimotor stimulation is provided through engagement with objects such as balls, boards, ladders, tunnels, ropes, chains, and increased 'exercise' is stimulated through larger available cage size and occasional running wheels (Nithianantharajah & Hannan, 2006). Social stimulation is facilitated as an increased numbers of rodents roam around within the cage, providing frequent social encounters between the animals (Nithianantharajah & Hannan, 2006). Cognitive stimulation is enhanced through changing and rearrangement of cage equipment as it requires the rodents to adapt to new situations and formulate new spatial maps of their environment (Nithianantharajah & Hannan, 2006). In occasional laboratory situations, access to water, food and treats has been manipulated, and rodents had access to these when successful in completing mazes or tunnels within the enriched cage (Knieling et al., 2009). The most recent research in stroke models however, do not provide any restrictions to food and water (Jeffers & Corbett, 2018).

Healthy rodents exposed to an enriched environment have been shown to have larger brains with greater cerebral weight, increased cortical depth, and dendritic tree branching has shown increased numbers of spines and greater synaptic numbers (Walsh, 1981). Animals inhabiting an enriched environment have shown that their brain undergoes cellular and molecular changes, which resulted in increased synaptogenesis (Johansson & Belichenko, 2002) and neurogenesis (Clemenson et al., 2015). Furthermore, environmental enrichment in healthy animals improves learning and memory, resulting in a reduction in anxiety, and positively in an increase in exploratory behaviour (Nithianantharajah & Hannan, 2006). The enriched environment studies in healthy animals resulted in exploration of environmental enrichment in rodent models of a variety of neurodegenerative

conditions such as Alzheimer's disease, Huntington's disease, Parkinson's disease and in a variety of brain injury including stroke (Nithianantharajah & Hannan, 2006).

The enriched environment intervention in rodents post stroke is designed to enhance motor, sensory, social and cognitive activity by creating a stimulating environment during the whole day (Jeffers & Corbett, 2018; Nithianantharajah & Hannan, 2006). It is predicated on the concept that exposure to such an environment will encourage activity in these domains. Extensive research in the enriched environment in post stroke rodents has demonstrated that the stimulating environment facilitates plasticity on a cellular, molecular level and behavioural level. On a cellular and molecular level structural alterations seen in rodents post stroke in an enriched environment include altered cortical maps (Johansson, 2000), increased dendritic spine density (Biernaskie & Corbett, 2001; Johansson & Belichenko, 2002; Xu et al., 2009), angiogenesis (Chen et al., 2017; Yu et al., 2014), neurogenesis (Komitova et al., 2006; Venna et al., 2014), increased level of neurotrophic factors such as brain derived neurotrophic factor (BDNF) (Gobbo & O'Mara, 2004; Venna et al., 2014), and reduced infarct volume (Johansson & Belichenko, 2002; Zhang et al., 2017). (See figure 2.2)

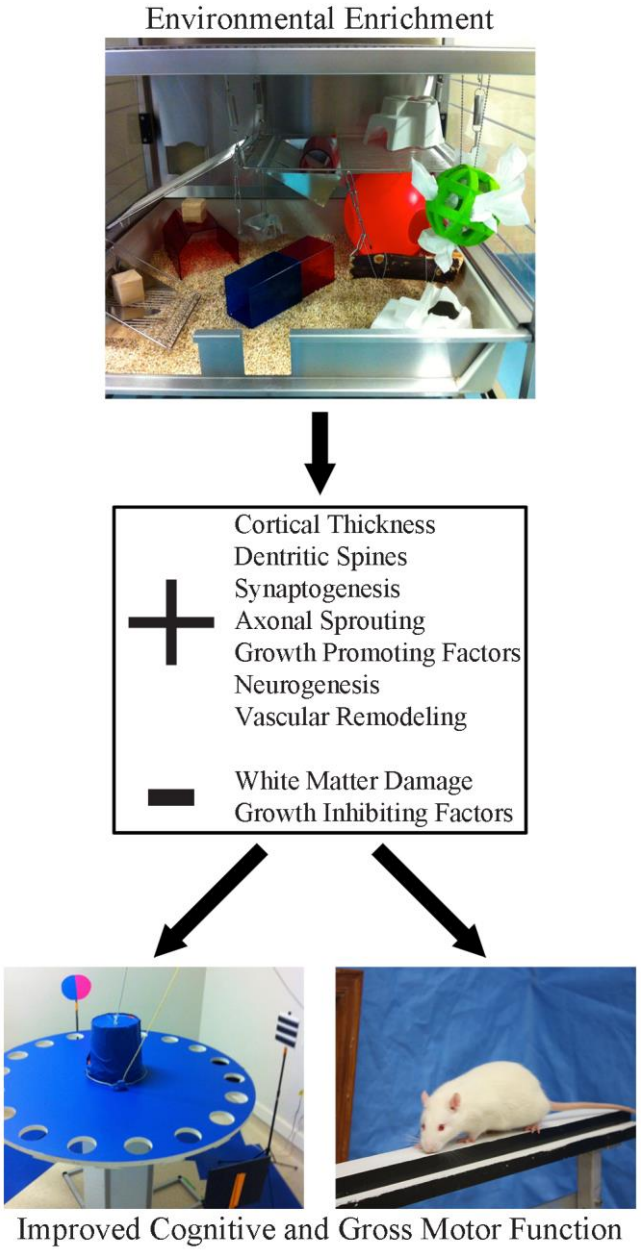

Figure 2-3 Environmental enrichment is a multifaceted form of housing that provides enhanced motor, cognitive and social stimulation, relative to the standard conditions of rodent housing. This form of housing has been shown to create widespread changes in the neuroplastic milieu of the brain. Following stroke, these beneficial changes create a neural environment that is permissive to recovery, resulting in robust improvements in both cognitive and gross motor function.

Reproduced from original article: 'Is environmental enrichment ready for clinical application in human post-stroke rehabilitation?' McDonald, Hayward, Rosbergen, Jeffers and Corbett 2018 Frontiers in Behavioral Neuroscience (under revision review).

At a behavioural level, an enriched environment has been shown to improve function such as improved fine and gross motor skills in rodents (Biernaskie et al., 2004; Johansson, 2004; Nygren & Wieloch, 2005; Ohlsson & Johansson, 1995), and enhance learning and memory, decrease anxiety and increase exploratory activity in rodents after stroke (Buchhold et al., 2007; Janssen et

al., 2010; Jha et al., 2011; Kobayashi et al., 2002; Xu et al., 2009).

The question of whether there is an optimal time to start exposure to an enriched environment is currently unanswered. The majority of studies in rodents start as early as one to two days post stroke. Rodents who were exposed to an enriched environment 24-hours after focal injury demonstrated no further increase in infarct size, and demonstrated greater functional recovery than rats housed in standard conditions (Johansson, 2004; Komitova et al., 2005; Ohlsson & Johansson, 1995; Risedal et al., 1999). Furthermore, delaying start of environmental enrichment results in a certain time point after which sensorimotor improvement rate slows down (Biernaskie et al., 2004). This suggests that exposure to an enriched environment 24-hours after stroke is effective in rodent models. The significant evidence from the enriched environment in rodents and the knowledge that stroke survivors remain inactive and alone during their rehabilitation paves the way to investigate the effect of an enriched environment in the clinical setting.

Clinical translation of components of 'enrichment' in human stroke population has been previously undertaken. In these studies a change to the stroke survivors' environment was made through adding music, gaming, or reading. A randomised controlled trial, which evaluated listening to self-selected music for one hour a day, compared to simply listening to audio books or receiving usual care, showed a significant positive effect on memory, attention and mood in favour of listening to self-selected music (Sarkamo et al., 2008). Further investigation using advanced MRI imaging showed that the listening to music increased grey matter volume in frontolimbic areas, which was associated with improved cognitive function (Sarkamo et al., 2014). This suggests that there may be a connection between music and stroke recovery but there is no clear indication as to how music listening results in better outcomes. Participants in a study exploring music listening after stroke reported that listening to self-selected music positively distracted participants from concerning thoughts, and that mindful music improved relaxation and emotional control (Baylan et al., 2018). A recent systematic review including 29 studies using music interventions in ABI patients showed that music may have a beneficial effect on gait, upper limb function, communication outcomes and quality of life (Magee et al., 2017). Taken together, music appears a powerful stimulating activity and may be a useful tool in an enriched environment in acute stroke patients.

Gaming such as Nintendo Wii can be used for physical, cognitive and social activity depending on which type of game is being played. A few studies have investigated Nintendo Wii in conjunction with usual rehabilitation in stroke survivors and found positive effects on physical performance (Mouawad et al., 2011; Yong Joo et al., 2010). In addition, stroke survivors reported that the gaming activity was enjoyable and satisfactory. However, these studies were small, and it is

unclear which specific mechanism resulted in the observed physical outcomes. Although the mechanisms of effects were unclear, gaming may be a positive stimulating activity to reduce boredom and increase physical, social and cognitive activity in inpatient settings. A small study involving reading groups for stroke survivors in the acute setting was already mentioned in the introduction chapter. In brief: the study found that stroke survivors perceived a reading group activity positively for entertainment and social activity (Higgins et al., 2005). While these studies have used components of enrichment, the first study to translate the 'model of enriched environment' as used in animal models to the clinical setting was undertaken by Janssen et al. in the subacute inpatient rehabilitation setting (Janssen et al., 2014b).

Janssen et al. was the first to translate a full conceptual model of enriched environment as defined and investigated in animal models into the clinical setting to enhance environment-driven activity (Janssen et al., 2014b). Engagement in physical, social and cognitive activity was voluntary as the stroke survivor decided how much they actively engaged in the stimulating environment. The study aimed to be cost effective and to only purchase resources, but no other additional expenses were made with regards to the intervention (Janssen et al., 2012). The study enriched the rehabilitation environment for stroke survivors on the ward and at the stroke survivors' bedside. Resources were used to enrich communal ward areas, with access to computers with internet connection, reading materials, puzzles, board games, gaming and recreational activity on Saturdays. Personal enrichment involved resources selected by the individual stroke survivor. Resources available were music, audio books, puzzles and games. In addition, families were asked to bring in hobby activities of the stroke survivor. Staff were asked to encourage stroke survivors to attend a communal area if stroke survivors were observed to be inactive. The primary outcome of 'any activity' was determined using behavioural mapping. 'Any activity' was defined as the stroke survivor performing a physical, social or cognitive activity, or any combination of activities in these domains (Janssen et al., 2012). In providing stimulating resources in the rehabilitation environment, stroke survivors were shown to be 1.2 times more likely to be active in 'any activity' ($p=0.02$) when compared with the control group [activity change from timepoint 1 to timepoint 2 (ΔT1-T2): 13% EE vs. 2% control]. Furthermore, stroke survivors were 1.2 times more likely to be engaged in a social activity ($p<0.001$) (ΔT1-T2): 3% EE vs. -5% control) and 1.7 times in a cognitive activity ($p<0.001$) (ΔT1-T2: 7% EE vs. 1% control). However, no significant change between groups was found for physical activity: 1.1 times more likely to be engaged in a physical activity ($p=0.21$) (ΔT1-T2): 8% EE vs. 5% control)(Janssen et al., 2014b) (see figure 2.4). A strength of this study was that through relatively simple inclusion of resources in the rehabilitation environment an increase in activity levels was achieved. Limitations included that the pilot study was small, with n=15 participants in the enriched and n=14 in the control group, and no significant increase in

physical activity was observed. Furthermore, impact of the intervention on secondary outcomes of adverse events, and length of stay were not investigated. Finally, the enriched environment component of the study was conducted within 3-months, which prevents developing an understanding of whether the intervention could maintain increased activity levels over a prolonged period of time.

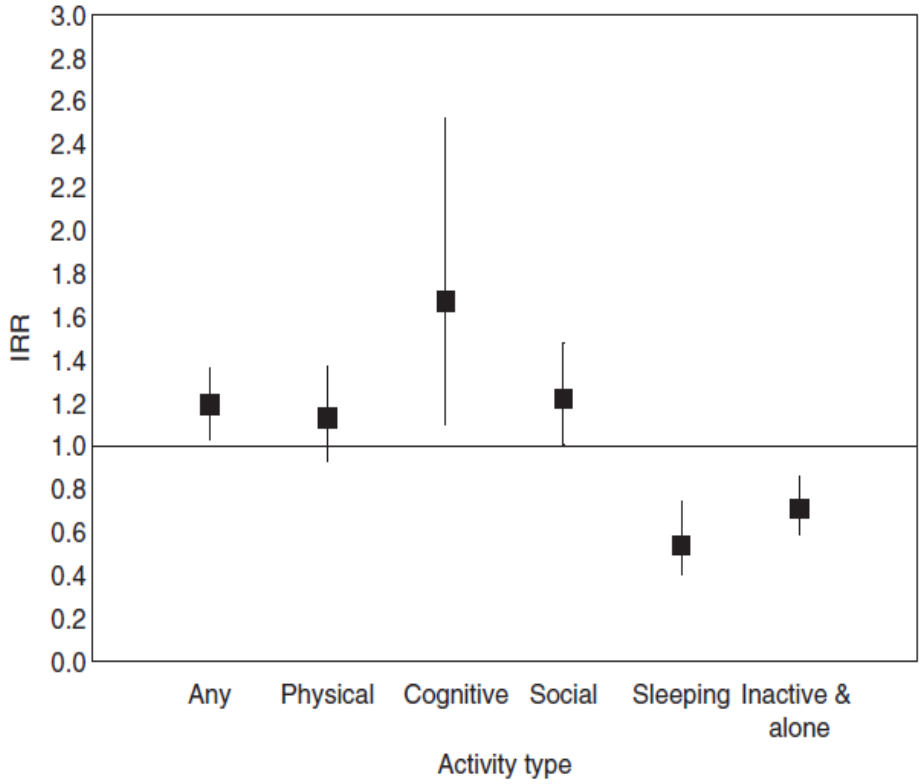

Figure 2-4 IRR (95% CI) between experimental and control group (where control group served as reference group) for activity type. Horizontal line at 1.0 represents line of no difference.

Reproduced from original article: An enriched environment increases activity in stroke patients undergoing rehabilitation in a mixed rehabilitation unit: a pilot non-randomised controlled trial. Janssen et al., 2014 Disability and Rehabilitation

To understand the experiences and perceptions from stroke survivors exposed to an enriched environment semi-structured interviews were conducted (White et al., 2015b). Results showed that stroke survivors perceived that personal and ward enrichment increased their activity levels and promoted social opportunities. It was reported that stroke survivors with insight into their medical condition would enhance their own recovery through increased participation in activities outside therapy hours. This suggests that when stroke survivors have increased awareness of the benefit of activity after stroke they may motivate themselves to increase their activity levels outside therapy

hours. In addition, stroke survivors reported that the enriched environment provided a choice of being active and less bored and gave a sense of increased personal control. Significant barriers identified during interviews included dependence in mobility. These stroke survivors reported feelings of frustration as they experienced difficulties in accessing enriched communal ward areas (White et al., 2015b). This information provides important translation targets to enhance access to enrichment areas. A limitation of this study was that carer perspectives were not investigated, and carers are important stakeholders in stroke survivors' recovery.

Staff perspectives on the introduction of an enriched environment were also investigated using semi-structured interviews (White et al., 2014). Staff involved in the enrichment study were asked to reflect on the usual care delivery within the rehabilitation unit, and their experience during the enrichment period. Overall staff felt that enrichment was positive, as it offered stimulation to stroke survivors, whom they noted to be less bored. A limitation perceived by the majority of staff members interviewed showed that they perceived that the enriched environment increased workload, and that they were already so busy during routine care. The main barrier identified by staff was the need to provide mobility assistance for dependent stroke survivors. Staff indicated that mobile stroke survivors were more likely to access enriched communal areas compared with dependent stroke survivors. In addition, staff reflected that stroke survivors were frequently tired from their therapy sessions in the afternoon, and perceived that stroke survivors were probably too tired to engage in enrichment activities (White et al., 2014). Taken together, qualitative exploration showed that staff and stroke survivors were positive regarding the enriched environment. Main barriers identified were provision of assistance for mobility in dependent stroke survivors and the perception of an increase in workload for staff. This highlights key targets for enhancing staff experience of working in an enriched environment and an indication of possible change management strategies required, particularly in an acute stroke unit, where some patients are likely to be more dependent, is fast paced, and where frequent turnover of patients occur.

A different enrichment study that used an enriched environmental program in subacute inpatient rehabilitation for neurological patients (including stroke survivors) used an arcade approach (Khan et al., 2016). In this study neurological patients in the control group had access to the usual rehabilitation environment equipment, which included access to computers, television, games and music. The intervention group had access to the same rehabilitation environment equipment, and had the additional opportunity to be engaged in a daily 'Activity Arcade'. The Activity Arcade provided 2-hours of extra daily activity and was constantly staffed by an AHA and nurse. Patients could choose activities they preferred to be engaged in, and novel activities available in the Activity Arcade were e.g. computers, gaming, a library corner, music station, shopping corner

and craft/ wood workshop area. Results of this study showed that patients in the intervention group had a significant favourable result in reduced depression and anxiety scores, and significantly improved mobility scores as measured in the Functional Independence Measurement (Khan et al., 2016). However, patient activity was not reported on, thus the impact of enrichment on activity levels is unknown. Limitations of this study included that enrichment involved an additional 2-hour access to the Activity Arcade on top of usual care, which deviates from enrichment in animal models where environmental enrichment is offered 24-hours a day. In addition, no details regarding staff perceptions were investigated in this study, despite the intervention making a substantial impact on rehabilitation routine.

Thus, stroke survivors have been shown to be inactive and alone in acute stroke units for decades despite compelling evidence to suggest that the acute and early subacute time window after stroke is a crucial window for plasticity. Furthermore, stroke survivors report to feel bored and unstimulated and want more opportunities to be meaningfully active early after stroke. Rodent models post stroke have demonstrated that an enriched environment in the acute and early subacute period improves functional outcomes, learning and memory with environmental enrichment initiated as early as 24-hours post stroke. In addition, first clinical translation to human patients in the subacute inpatient rehabilitation phase has shown promising results with increased activity levels, reduced depressive symptoms and improved function. Yet, the enriched environment has not been investigated in the acute stroke unit. The acute stroke unit is a unique setting where stroke survivors are more dependent, require many observations and investigations, and length of stay is shorter. This thesis will build on and adapt the enriched environment used in the subacute inpatient rehabilitation setting to suit the acute stroke setting and will take into account the evidence available as discussed in this chapter to develop an enriched environment intervention tailored to the acute stroke unit.

2.2 Thesis aims and objectives

Stroke survivors are inactive and alone in acute stroke units. There is strong evidence that increased physical activity promotes functional recovery after stroke, and a growing body of evidence becomes available suggesting that increased social and cognitive activity supports recovery after stroke. As the number of stroke survivors is expected to rise in the future, innovative interventions are needed that can increase activity levels in stroke survivors. The enriched environment has the potential to increase activity levels in all activity domains within current staffing levels. Thus, the aim of this program of studies is to determine feasibility of embedding an enriched environment in an acute stroke unit and if an enriched environment can increase 'any, physical, social and cognitive activity levels in acute stroke patients, and if this can be sustained. A program of studies has been developed using quantitative and qualitative designs, to contribute to the evidence of clinical translation of environmental enrichment into clinical human population with acute stroke.

Study 1 (Chapter 4): A controlled before-after observational pilot study was designed with the aim to determine if an enriched environment embedded in acute stroke unit results in an increase in 'any', physical, social and cognitive activity levels (primary outcome measures) in acute stroke patients. In addition, this study aimed to determine whether the enriched environment within an acute stroke unit results in better functional outcomes, reduces adverse events, depression and anxiety and decreases length of stay (secondary outcome measures).

Study 2: (Chapter 5): This study aimed to determine the sustainability of an enriched environment in an acute stroke unit. After the initial controlled before-after observational study an additional follow up group was recruited to determine if an increase in activity levels in stroke patients were sustained 6-months post implementation of the enriched environment.

Study 3 (Chapter 6): This study used the observational data collected in the before –after study to determine which components of the enriched environment had the greatest effect on activity domains, and on the timing and nature of patient activity. In addition, this study aimed to identify the amount of staff assistance provided to facilitate patient activity.

Study 4 (Chapter 7): This qualitative study used semi-structured interviews with nursing and allied health professionals aimed to investigate the experiences and perceptions of staff working in the enriched acute stroke unit environment. In addition, staff surveys during control and enriched period were collected with the view to determine staff satisfaction, perceptions of workload and team efficacy of an enriched environment. Brief surveys with patients and carers aimed to determine patients and carers' acceptance of an enriched environment in an acute stroke unit.

2.3 Significance

Current acute stroke units provide limited opportunities for stroke survivors to be involved in physical, social and cognitive activities. With growing populations and current tight fiscal constraints in hospitals, there is a strong need for interventions that can improve stroke survivor and service outcomes without making a substantial increase in cost. The enriched environment is a challenging, new interdisciplinary approach to increase activity, and enable patient-centered care within an acute hospital setting. Each discipline has to expand their scope of practice and contribute to create a stimulating ward. The findings will identify if an enriched environment can safely increase activity with acute stroke patients within existing staffing levels, and provide direction about 'early rehabilitation' in the acute stroke unit. If the enriched environment proves feasible, and is successful in increasing activity levels, it may demonstrate a trend towards improved functional outcomes, reduced adverse events and shorter length of stay in an inpatient setting. If positive trends are demonstrated it will provide a platform for future research on a larger scale with sufficient power to demonstrate other changes such as functional improvement and cost-effectiveness, possibly across both the acute and subacute phases of rehabilitation. Demonstration of meaningful functional or quality of life gains from such an intervention could have enormous impact on stroke service delivery in Australia and beyond. The enriched environment concept could also be translated and investigated in other patient categories such as acute medical and geriatric patients.

Chapter 3 is adapted from the following publication
(Appendix 4 URL Link to Published Paper)

The effect of an enriched environment on activity levels in people with stroke in an acute stroke unit: Protocol for a before - after pilot study

Rosbergen ICM, Grimley RS, Hayward KS, Walker KC, Rowley D, Campbell AM, McGufficke S, Robertson ST, Trinder J, Janssen H, Brauer SG.

Pilot and Feasibility Studies 2016;2(1):36.

and was presented at

Stroke Society of Australasia, Hamilton Island, Australia, August 2014.

(Poster presentation)

Chapter 3 Study Methodology

3.1 Abstract

Background: Clinical practice guidelines advocate engaging stroke survivors in as much activity as possible early after stroke. One approach found to increase activity levels during inpatient rehabilitation incorporated an enriched environment, whereby physical, cognitive and social activity was enhanced. The effect of an enriched environment in an acute stroke unit has yet not been explored.

Methods: We aimed to perform a prospective non-randomised before - after intervention study. The primary aim was to determine if an enriched environment can increase physical, social and cognitive activity levels of people with stroke in an acute stroke unit compared to usual care. Secondary aims were to determine if the enriched environment improved functional outcomes, resulted in fewer adverse events and shorter length of stay. We aimed to recruit 90 people with stroke: 30 to a usual care block, 30 to an enriched environment block, and 30 to a sustainability block. Participants were recruited within 24-72 hours after onset of stroke, and each block was estimated to last for 12-weeks. In the usual care block usual management and rehabilitation within an acute stroke unit occurred. In the enriched environment block the acute stroke unit environment was adapted to promote greater physical, social and cognitive activity. Three months after the enriched environment block we recruited another 30 participants to determine sustainability of this intervention. The primary outcome was change in activity levels measured using behavioural mapping over 12-hours (7.30am to 7.30pm) across two weekdays and one weekend day within the first 10-days of admission to the acute stroke unit. Secondary outcomes included functional outcome measures, adverse and serious adverse events, and length of stay.

Discussion: There is a need for effective interventions that starts directly in the acute stroke unit. The enriched environment is an innovative intervention that could increase activity levels in stroke survivors across all domains and promote early recovery of stroke survivors in the acute setting.

3.2 Background

Stroke survivors who receive care in an acute stroke unit are more likely to be alive and independent compared with stroke survivors managed with general ward care (Stroke Unit Trialists' Collaboration, 2013). Characteristics of the acute stroke unit considered to contribute to these outcomes include early mobilisation and multidisciplinary coordinated rehabilitation (Langhorne & Pollock, 2002) to prevent immobility-related complications (Govan et al., 2007), and commence functional recovery early after stroke. Strong evidence indicates that increased engagement in physical activities targeting mobility and upper limb function early after stroke result in improved functional outcomes (Veerbeek et al., 2014). Yet, despite awareness of the positive effects of increased physical activity, available evidence indicates that stroke survivors spend the majority of the day physically inactive and alone early after stroke (West & Bernhardt, 2012).

Social support has been recognised as an important determinant of health-related quality of life of stroke survivors (Kruithof et al., 2013). The relationship between various types of social support such as emotional, instrumental or informational support, as well as quality of life is inconsistent (Kruithof et al., 2013). Some studies have found that high levels of social support are associated with larger improvements in functional status (Glass et al., 1993; Tsouna-Hadjis et al., 2000). It is argued that social support can offer encouragement, assistance and increase compliance with treatments (Harris et al., 2010; Tsouna-Hadjis et al., 2000), and assist in dealing with the consequences of stroke (Kruithof et al., 2013). However, not all aspects of social support may be beneficial. For example, instrumental support may lead to poorer health if someone becomes dependent on the provided assistance (Latham et al., 2015). Limited evidence is available regarding cognitive activity after stroke. Cognitive activity such as listening to music during early recovery has been shown to enhance focused attention (Sarkamo et al., 2014), lessen depressed mood (Sarkamo et al., 2014) and improve visual attention in those with unilateral neglect (Tsai et al., 2013). Despite these possible benefits, little is known regarding social and cognitive activity levels in stroke survivors early after stroke.

There is a need to identify interventions that can increase activity levels across physical, social and cognitive domains, and concurrently have a positive effect on outcomes early after stroke. One possible intervention is an enriched environment. As described in section 2.1.10, in animal research, an enriched environment is defined as an organised stimulating environment to enhance social stimulation and sensory, motor and cognitive activities (Nithianantharajah & Hannan, 2006). A systematic review and meta-analysis in animal research of stroke has shown that an enriched environment has a positive effect on physical recovery, learning and exploratory

behaviour, which includes reduced decline in memory and levels of anxiety (Janssen et al., 2010). A pilot study of enriched environment in people with stroke was recently undertaken in the sub-acute inpatient rehabilitation setting (Janssen et al., 2014b). This study showed promising results, with increased activity levels demonstrated across activity domains (Janssen et al., 2014b). An enriched environment was achieved within subacute rehabilitation in this study by creating communal areas with stimulating equipment, and individual enrichment through provision of personal equipment such as music and hobby activities (Janssen et al., 2014b). An enriched environment can provide activities that are meaningful and tailored to each stroke survivor as a wide variety of activities can be included in an enriched clinical setting. In addition, novel advanced technology such as virtual reality, iPads, and active gaming technologies, can be a valuable addition to provide stimulation to stroke survivors with a therapeutic effect (Bower et al., 2014; Des Roches et al., 2014; Laver et al., 2011). More conventional enrichment strategies could involve music and art, as these activities have shown to reduce boredom and a positive effect on mood in stroke survivors (Baumann et al., 2013; Kim et al., 2011).

Taken together, it is plausible that the implementation of an enriched environment immediately post stroke within an acute stroke unit could positively influence activity levels across all domains, lead to fewer adverse events and improved functional outcomes. This pilot study aimed to determine the effect of implementing an enriched environment in an acute stroke unit on physical, social and cognitive activity levels, functional outcomes and adverse events. We hypothesised that stroke survivors who start their rehabilitation journey in an acute stroke unit with an embedded enriched environment will be more active, achieve greater functional outcomes and better mood, experience fewer adverse events and have a shorter length of stay (LOS) compared to stroke survivors who start their rehabilitation journey in an acute stroke unit without embedded enriched environment.

3.3 Methodology

3.3.1 Design

This suite of studies that will be described in Chapter 4 and 5 involved a prospective non-randomised before-after design. We aimed to recruit 30 people with stroke to usual care (Block 1) and subsequently 30 to the enriched environment intervention (Block 2). We evaluated activity levels across all domains, functional outcomes and adverse events within both blocks. Following

Block 1, an enriched environment was embedded in the same acute stroke unit during a 6-week period before commencement of Block 2. To determine if embedding an enriched environment within an acute stroke unit persists, activity levels were re-evaluated 3-months post Block 2 (enriched environment) with an additional 30 stroke participants recruited (Block 3 sustainability). This study was conducted in accordance with the Declaration of Helsinki. Ethical approval was obtained from the Metro North Hospital and Health Service, The Prince Charles Hospital (TPCH) Human Research Ethics Committee (HREC) approval number HREC/14/QPCH/21 (Appendix 1), and The University of Queensland (UQ), Medical Research Ethics Committee (MREC) approval number MREC/2014000371 (Appendix 2). In addition, Public Health Act Approval was obtained to access confidential information from medical records (Appendix 3). The study was prospectively registered with the Australian New Zealand Clinical Trials Registry (ANZCTR12614000679684).

3.3.2 Participants and setting

All recruitment for this study was conducted in the same acute stroke unit in a regional Australian acute hospital. The acute stroke unit was an endorsed unit with 470 stroke admissions per annum, an average acute length of stay of 4.1 days, and an in-hospital mortality rate of 17%. Rehabilitation by a multidisciplinary team commenced on the day of admission, with transfer to general inpatient rehabilitation units (public and private) if length of stay was predicted to be greater than 7-10 days. Several community-based rehabilitation services were available spanning home and center-based, and slower transition care. The acute stroke unit had eight funded stroke beds and is embedded within a 16-bed ward (eight single rooms and four double rooms). The ward was supported by 2.0 Fulltime Equivalent (FTE) physiotherapists, 1.6 FTE occupational therapists, 1.0 FTE speech therapist, 1.0 FTE social worker, 0.5 FTE dietitian and 0.7 FTE therapy allied health assistant.

All stroke survivors admitted to the hospital were screened for eligibility with consecutive recruitment of eligible participants. Recruitment was estimated to occur over 12-weeks, or until the target number was reached.

Participants were included if they were:

1) Admitted to the acute stroke unit within 24-72 hours after onset of stroke (ischemic or haemorrhagic, first and/or recurrent stroke). The rational for this window of time is 24-hours post onset aligns with animal models of enrichment (Johansson, 2004), and admittance within 72-hours

after stroke onset allowed for inclusion of stroke survivors who were admitted over the weekend. Furthermore, we included all stroke types, first and recurrent stroke, which ensured a broad variety in our sample as this was a pilot study.

2) Able to complete a transfer from bed to chair with assistance of two persons or less. This criteria excluded stroke survivors who were unable to participate in frequent daily activities early after stroke, as they were presumed to not be able to engage in the enriched environment.

3) Able to follow single stage commands, as severe receptive language or cognitive deficits precluded participation in enrichment strategies.

4) Requiring assistance for basic activities of daily living (ADLs). This criteria was required as stroke survivors who were independent in ADLs were likely discharged within two days after admission to the acute stroke unit, thus representative activity data could not be collected. In addition, independent patients would be unable to improve in functional outcome measures due to a ceiling effect.

5) Able to walk independently premorbidly, consistent with a score ≥ 4 as measured with the Functional Ambulation Category (Mehrholz et al., 2007). This criteria ensured recruited cohorts had a similar premorbid status of walking to reduce variability in this pilot sample, and to ensure the sample had the potential to engage in the enriched environment.

6) Admitted with a premorbid modified Rankin Score (mRS) of ≤ 2 from self-report. This ensured that participants had a similar expected prognosis (Quinn et al., 2017), allowed comparison with other completed acute stroke research (Banks & Marotta, 2007), and ensured participants had the potential to engage in the enriched environment.

Participants were excluded if they had:

1) A retrospective premorbid mRS of ≥ 3. An investigator first obtained information related to participants' premorbid function available through self-report after admission. However, complete information related to prior functional status was not always directly available, so when mRS≥ 3 was established with additional gathered information participants, were excluded.

2) A concurrent diagnosis of rapidly deteriorating disease. A rapid decline in functional status likely affected activity and 3-months outcome data independent of the intervention. In addition, these participants have frequently important medical and family issues that need to be prioritised.

3) An extensive psychiatric history. This criteria was required because an extensive psychiatric history likely precluded the ability to participate in enrichment strategies.

To allow for observational data collection, and for assessment and re-assessment of secondary outcomes, stroke survivors were also excluded if discharge from the acute stroke unit was expected within 2-days of admission. Informed consent was obtained from participants or their substitute decision maker. Participants were informed that the project aimed to compare an alternative model of rehabilitation with the traditional model of rehabilitation, but not informed regarding the specific intervention being investigated or group allocation (Appendix 5 and 6 Consent form stroke survivor and substitute decision maker).

3.3.3 Baseline measures

Baseline measures included: demographics (e.g. age, sex); premorbid mRS (Quinn et al., 2017) and living arrangements (classified as living alone or with others); stroke details such as date, estimated time of onset, lesion location and type, and Oxford Stroke Classification (Bamford et al., 1991; Mead et al., 2000). Stroke severity was classified according to National Institutes of Health Stroke Scale (NIHSS) on admission (day 1 if thrombolysed) into the categories: mild (<8), moderate (8-16) and severe (>16) (Briggs et al., 2001). The NIHSS is a reliable tool to evaluate and document neurological status after stroke, and quantifies the level of stroke severity weighted on assessment findings (Goldstein & Samsa, 1997).

3.3.4 Intervention

In the 12-week usual care block, participants received usual acute stroke management per Australian clinical guidelines for stroke management (Stroke Foundation, 2010). Rehabilitation was delivered in one-on-one interventions by therapists to stroke participants. At this site therapists had access to a common therapy room, which was located within the acute stroke unit. Discipline-specific AHAs were available for therapy interventions that required the assistance of 2 persons, or facilitated increased practice through individual treatment sessions. The stroke unit had access to the Graded Repetitive Arm Supplementary Program (GRASP), which is a self-directed upper limb exercise program for stroke patients (Harris et al., 2009). Staffing levels were monitored across the study period to ensure they remained consistent across both blocks.

After the usual care block there was a 6-week period in which the environment of the acute stroke unit was adapted. Equipment to enrich the environment was purchased by the acute stroke unit and included communal tables, a trolley, subscription to newspapers, iPads, iPods, books, puzzles, games, audio books, Wii Fit Plus including a balance board, and hotel reception bells. Prior public space in the unit was converted into three small communal seating areas: in front of the elevators, at the end of the corridor, and next to the main reception desk. In these communal areas participants had access to stimulating equipment during and outside therapy hours e.g. iPods loaded with music, books, board games, puzzles, magazines, DVD movies, and newspapers. Each communal area had 'bells', to allow participants to alert staff if required. In order to create opportunities to deliver activities at the participants' bedside, the research team created an activity trolley, which contained reading books, puzzles, magazines, board games, and nature display books. The trolley was placed in the main corridor, next to the therapy gym, and nursing staff were asked to daily offer activities after dinner at the participant bedside. Appendix 7, enriched environment protocol, provided details of the different enrichment strategies to enhance physical, social and cognitive activity, and included details around staff responsibilities.

In the enriched environment block, communal areas were used to enhance individual and group activities. On three weekdays (Tue-Wed-Thur) an interactive breakfast (7am-8am) and every weekday an interactive lunchtime (12pm-1pm) was organised. These scheduled interactive mealtimes aimed to increase the frequency of mobilisation, encouraged sitting upright for mealtimes and stimulated social interaction. Therapists made a daily list of patients who were suitable to attend scheduled communal meal times, and mealtimes occurred in the therapy gym within the acute stroke unit. For each breakfast or lunch mealtime, tables and chairs had to be set up in the therapy gym to enable communal meals. Physiotherapists and AHAs were responsible for patients to be mobilised to the communal eating area and received assistance from other nursing and allied health staff. Staff present during mealtimes facilitated patients in independence in consuming meals and encouraged nutritional intake in participants. See Appendix 7 for details. Participants were every communal mealtime encouraged to voluntarily attend. No change in staffing levels occurred within the enriched environment, and any staff time in group/ meal sessions was diverted from previous 1:1 therapy time. AHAs played the main role in managing communal mealtimes.

A daily group session was implemented, focussing on different aspects of stroke recovery: we started scheduled group activities (2.30pm-4pm) on weekdays to provide regular activity opportunities spread across the day. Group activities had a strong multidisciplinary emphasis. On Monday and Friday, group activities focused on 'physical activities' including balance and ambulation led by a physiotherapist and AHA, on Tuesday 'social support and stroke education'

was provided by the social worker, clinical nurse coordinator and dietitian, Wednesday included 'communication enhancement', which was delivered by a speech therapist and AHA, and Thursday included 'upper limb and cognitive activities' provided by an occupational therapist and AHA. Participants who could benefit from group activities were encouraged to participate (Appendix 7).

To encourage activity at the participants' bedside, therapy and nursing staff offered self-directed exercise programs, iPads loaded with apps, iPods loaded with music, books, board games, puzzles, magazines, newspapers and music. These activities were placed at the participants' bedside and were available 24-hours of the day. Self-directed exercises included the GRASP, and iPad therapy apps for speech, cognition and hand dexterity that encouraged independent practice of physical and cognitive activities. Each patient in the acute stroke unit had access to paid television, which is a hospital policy. The research team did not encourage watching television, but each individual participant decided if they wanted access to television. In addition, the research team created activity cards; each allied health discipline created 10 activity cards outlining specific activities. Fifty activity cards were available to encourage a wide range of physical, social and cognitive activities e.g. bed exercises, upper limb exercises, to go outdoors with family, speech exercises, relaxation exercises, and listening to music. It was agreed that each participant received 5 activity cards, which were tagged on the wall at the patient bedside, including activities that were relevant, meaningful and tailored to the participant, and that encouraged activity outside of therapy hours, and weekends. See Appendix 8 for examples of activity cards.

To encourage participant and family involvement we provided participants and families with a brochure in the enriched environment block (see Appendix 9). Three staff members (IR, KW, AC) recruited participants to the study and were responsible for providing and explaining the brochure to participants and families. The brochure outlined the importance of frequent activity early after stroke, advised how families can be involved, and explained the day structure of the acute stroke unit. Families were advised to bring in personal items and hobby activities for the participant, and to encourage participants to engage in these activities outside therapy hours and on weekends.

Key staff members including therapists, nursing staff and medical specialists of the acute stroke team were utilised as local opinion leaders to assist development and implementation of the enriched environment intervention. To support staff in changing clinical practice we leveraged change management theories (Grol & Grimshaw, 2003). During the 6-weeks of embedding the enriched environment, staff focus towards enabling activity was reinforced through eight small interdisciplinary education sessions. Educational sessions were provided by the principal investigator (PI) and senior physiotherapist IR, and research team member and senior physiotherapist KW. All staff at all levels were invited to attend: nursing assistants, enrolled nurses,

registered nurses, clinical nurses, nursing clinical coach, therapy staff and AHAs. At these educational sessions, the enriched environment theoretical concept, enriched environment intervention, and 'enablers and barriers' of implementation of the intervention was interactively discussed (Middleton et al., 2011). We educated staff to encourage participants to attend communal areas, and to offer stimulating equipment to participants in communal areas and at the bedside. All staff received the enriched environment intervention protocol per email, which detailed the different components of enrichment and outlined transparent staff responsibilities. (Appendix 7)

In addition to interdisciplinary education, PI IR and clinical nurse coordinator DR appointed 12 nurse champions to encourage staff adherence to the intervention protocol on a daily basis. The PI informed nursing champions in a one-on-one session that they were expected to act as role models during the intervention. Further, they were informed to facilitate other staff to execute the intervention protocol and to use enablers in difficult busy situations such as liaising with allied health staff. When a staff member demonstrated adherence to the intervention, nurse champions were encouraged to provide positive feedback to the individual. Regular team meetings, communication with nurse champions, reminders on the ward, and newsletters that included patients and carers feedback and repetition of key intervention strategies were undertaken throughout the intervention phase to maintain effective implementation (Grol & Grimshaw, 2003; McCluskey & O'Connor, 2017). (Appendix 7)

AHAs were trained from discipline-specific to 'generic' AHAs for the enriched environment intervention. Training included that each AHA was trained in physiotherapy, occupational therapy and speech therapy AHA competencies related to stroke rehabilitation. By doing this, all AHAs working in the acute stroke unit were able to mobilise participants and assist all therapists during the study intervention period. All intervention strategies were implemented without changes in staffing levels. Staff were not blind to group allocation during the usual care and enriched environment period.

3.3.4.1 Fidelity of intervention

During the enriched environment intervention the PI monitored occurrence of meal times and group sessions, availability of resources, and provision of information brochures and documented if any component of the intervention was not delivered. The PI also monitored staffing levels across the study period to ensure consistency and minimise the impact of staffing levels as a confounder to results. We did not monitor for individual staff adherence. Our main measure for a successful

implementation was to determine if participants in the enriched environment intervention demonstrated significantly higher activity levels as compared to usual care, which was measured through behavioural mapping (see 3.3.5), and that the enriched environment was a safe intervention in the acute stroke unit measured through adverse and serious adverse events recording (see 3.3.6).

3.3.5 Primary outcomes

Activity levels were determined for 'any activity', physical, social and cognitive activity and time spent alone. 'Any activity' was defined as the stroke survivor performing at least one physical, social or cognitive activity or a combination of activities in these domains (Janssen et al., 2012). 'Any activity' was expressed as a percentage of the total number of observations performed, as was activity within physical, social and cognitive activity domains. The first 10-days after admission to the stroke unit was considered the primary exposure profile.

The behavioural mapping protocol by Janssen et al. 2012 (Janssen et al., 2012) has been adapted for this study to measure activity. Appendix 10, behavioural mapping protocol, provides details of the approach including definitions for all domains, specific observer procedures, and other details such as ward characteristics, layout, ward meetings, policies and patient characteristics on the ward. Physical, social and cognitive activity definitions and specific examples of activities listed in each domain were derived from the behavioural mapping protocol and are presented in Table 3.1.

Table 3-1 Behavioural mapping activity definitions including listed activities within each activity domain and body position, location and people present specified

Domain	*Definition*	*Listed activities*
Physical activity	Everyday personal, athletic, recreational or occupational activities that require physical skills and utilise strength, power, endurance, speed, flexibility, range of motion or agility.	Bed exercises, sitting unsupported, standing, transferring, walking, stairs, upper limb activity, dressing, toileting, showering, grooming, eating, drinking, upper limb management, other, no physical activity, unknown
Social activity	Any interaction, which involves verbal communication with people present or through telecommunication devices, and other non-verbal interactions.	Talking, laughing, touching, kissing, singing, telephone, communal socialisation, other, no social activity, unknown
Cognitive activity	Any non-physical leisure activity, which involves the patient actively engaging in a mental task.	Reading, listening, crosswords, puzzles, games, writing, watching television, computer/ iPad use, crafts, finance, playing an instrument, other, no cognitive activity, unknown
Body position	The patient's body position.	Supine, sitting in regency chair/ tilted wheelchair, sitting in chair/ wheelchair, sitting unsupported, standing, other, unknown
Location	Where is the patient located.	Bedside, ensuite bathroom, therapy room, communal areas, meeting rooms, amenities, off stroke unit, off site, other, unknown
People present	'Any' person in the near vicinity of the patient, which is conducive to interaction.	Medical staff, nursing staff, operational staff, medical imaging/ haematology staff, patients, therapist and students, allied health assistants, visitors, other, alone, unknown

Protocol adaptation included incorporating typical activities performed in the acute setting e.g. bed exercises, watching television, and listening. In the protocol used in the enriched environment study in the rehabilitation inpatient setting, 'watching television' and 'listening' were

not included. The research team in the acute stroke unit concluded that participants access to paid television at the bedside, as well as 'listening' to staff and visitors, were important activities to capture.

Participants were observed for 1-minute at 10-minute intervals from 7.30am till 7.30pm on Tuesday, Thursday and Saturday for a maximum of three mapping days or until discharge from the acute stroke unit, whichever came earlier. Capturing activity across one day is considered to be representative of patient activity (Bernhardt et al., 2004). We included observations on Saturdays, as activity has shown to be reduced on weekends (section 2.1.6.), and to determine if the intervention increased activity outside therapy hours. For each observation the main activity performed during 1-minute was recorded for each category. In addition, we reported if the participant performed the observed activity independently, supervised or with assistance. The participant's location, body position and people present were also documented. Participants can be engaged in 'no activity', and may perform activities across more than one domain concurrently e.g. participant was sleeping so 'no activity' in physical, social and cognitive domain were recorded, or participant was observed lying in bed while talking to someone on the phone (no physical activity recorded, and telephone use recorded as social activity, and listening recorded as cognitive activity).

During each observation the observer collected data for as many categories as able. When the observer was unable to view the participant due to activity precluding direct observation (e.g. participant is in the bathroom) an attempt was made to retrospectively estimate activity from nearby staff or the participant. Intervals where a participant was unable to be observed (e.g. off the ward for investigations), or activity unable to be estimated (e.g. curtain drawn) was classified as 'unobserved'. Unintentional non-observations were classified as 'missing data'. Unobserved and missing data did not contribute to the total number of observations for a participant. The reason for and proportion of 'unobserved and missing observations' was reported by group.

We appointed five behavioural mapping staff members who performed behavioural mapping across the usual care, enriched environment, and sustainability period of the study. Mapping staff members were allied health assistants from a variety of backgrounds (one behavioural mapper worked in a nursing home, another worked in a community rehabilitation centre, two behavioural mappers worked in the same hospital but in different ward areas, and one behavioural mapper was an occupational therapy student). Staff performing behavioural mapping received 4-hours of specific training. Research team member KH trained PI IR for 4-hours to obtain competency in behavioural mapping. After IR was trained and assessed as described below, KH and IR together trained the 5 appointed behavioural mapping staff members and 2 extra research team members (KW and AC). Training included explanation of category definitions, procedures, practice examples

and explanation of the behavioural mapping protocol (2,5 hours). Following the educational component staff members required to perform an assessment, which compromised observing 4 stroke patients for one hour, providing 24 observations. After the observations half an hour was used to discuss any difficulties and examples of observations made. Competency to record study data was defined as attaining ≥ 90% agreement with concurrent observations by the trainers IR or KH. Behavioural mapping staff members did not receive any study details nor were explained the aim of the study, and were blinded to group allocations.

3.3.6 Secondary outcomes

In the usual care and enriched group, an investigator (IR, KW, AC) collected secondary measures after enrolment to the study. Blinded assessors (senior physiotherapists) collected secondary measures within 24-hours of discharge from the stroke unit or when care was transferred to palliative intent. Blinded assessors worked in the same hospital but in other ward areas (intensive care unit, medical assessment unit and outpatient department), which were geographically distant from the acute stroke unit. Blinded assessors were aware of 'the enrichment study in the acute stroke unit' but had not received any information regarding study aims, methods, intervention and design. In addition, research team members were explicitly and repeatedly informed not to discuss study details within the allied health department to ensure blinding. Investigator and blinded assessors received MBI training by senior occupational therapist AC (3-hours). IR and KW were mRS accredited, and educated investigator AC and blinded assessors (2-hours). IR educated investigators and blinded assessors in other outcome measures and procedures (3 hours). At the time a participant required a discharge assessment from a blinded assessor IR would inform a blinded assessor. The blinded assessor received participant information outlined on section E in the 'Participant Data Collection Folder' (Appendix 16) to ensure patient safety during the assessment, but no other details were provided. Blinded assessors were instructed not to read the participant's medical chart, and only had access to the bed chart for participants' recent observation of vital signs. Duration of each assessment ranged from 45-90 minutes.

To assess physical ability, we collected the Mobility Scale for Acute Stroke (MSAS), which is a reliable and valid scale for measurement of mobility in the first 14-days post stroke (Simondson et al., 2003). To assess independence in activities of daily living, the Modified Barthel Index (MBI) was used, which has good sensitivity and reliability in the acute setting (Shah et al., 1989). To categorise level of functional independence post-stroke, the mRS was used, as it is a global outcome

rating scale that has shown inter-rater reliability (Quinn et al., 2008). This measure also allows comparison with previous acute stroke research (Banks & Marotta, 2007). We included the 10-meter walk test to assess walking ability, as it is a reliable tool to capture fastest walking speed (Collen et al., 1990). Self reported anxiety and depression was measured using the Hospital Anxiety and Depression Scale (HADS), which is divided in an anxiety and depression subscale. The Hospital Anxiety and Depression Scale has shown to have an excellent validity and test-retest reliability across small time windows (Aben et al., 2002; Bjelland et al., 2002).

The blinded assessor also collected secondary measures at 3-months post stroke via telephone interview. Blinded assessors organised and conducted the three months follow up telephone call independently without any communication with IR. We collected mRS and Health Related Quality of Life (HRQoL) using a component of the EuroQol 5 dimensions 3 level version (EQ-5D-3L) - Visual Analogue Scale (EQ VAS) (EuroQol group, 1990). Participants were asked to rate their current perceived health state imagining a visual analogue scale from 0 to 100, where 0 indicates worst imaginable to 100 best possible quality of health (Hunger et al., 2012).

Adverse events (AE) and serious adverse events (SAE) experienced by participants while in the acute stroke unit were recorded in an event registry using established definitions (Goldfarb, 2012). (Appendix 11 AE and SAE forms) Serious adverse events (SAE) were defined as an adverse event that led to death and/or led to serious deterioration in health of a patient, whereas Adverse Events (AE) were defined as any untoward or unfavourable medical occurrence in a patient. Complications recorded included falls, pneumonia, pressure areas, cardiac problems, seizures, reduced Glasgow Coma Scale, stroke, transient ischemic attack, urinary tract infection, depression, constipation, malnutrition, delirium, and “other” including shoulder pain, deep venous thrombosis and urinary retention (Goldfarb, 2012; Ostwald et al., 2013) Two study members (RG medical officer and IR physiotherapist/PI) independently rated all events and subsequently met to affirm consensus. If no consensus was reached a third study member was involved (KH). In addition, we documented total days spend (LOS) in the acute stroke unit for each participant measured from the day of admission to hospital till the day of discharge from the acute stroke unit.

3.3.6.1 Data collection time points

An investigator (IR, KW, AC) conducted the initial assessment on entry to the study. Blinded assessors performed discharge assessments immediately prior to discharge from the acute stroke unit or when a decision for palliative intent was made. Blinded assessors also undertook follow-up

phone calls at three months post-stroke to determine mRS, living arrangement, Health State Score EuroQol Visual Analogue Scale (EQ-VAS) (EuroQol group, 1990), and if any SAEs had occurred after discharge. (Appendix 16 Participant data collection folder) Three months after the enriched environment block, another period of behavioural mapping occurred to determine whether activity levels were sustained on the acute stroke unit in a follow up group (Block 3 Sustainability). We aimed to recruit another 30 participants using the same eligibility criteria and completed behavioural mapping on a single, randomly chosen day (Tues-Thur-Sat) from 7.30am till 7.30pm. The sustainability block will be explained in Chapter 5. A single day was chosen as limited funding was available. Please note that all methods for staff semi-structured interviews and staff, patient and carer surveys will be discussed in Chapter 7.

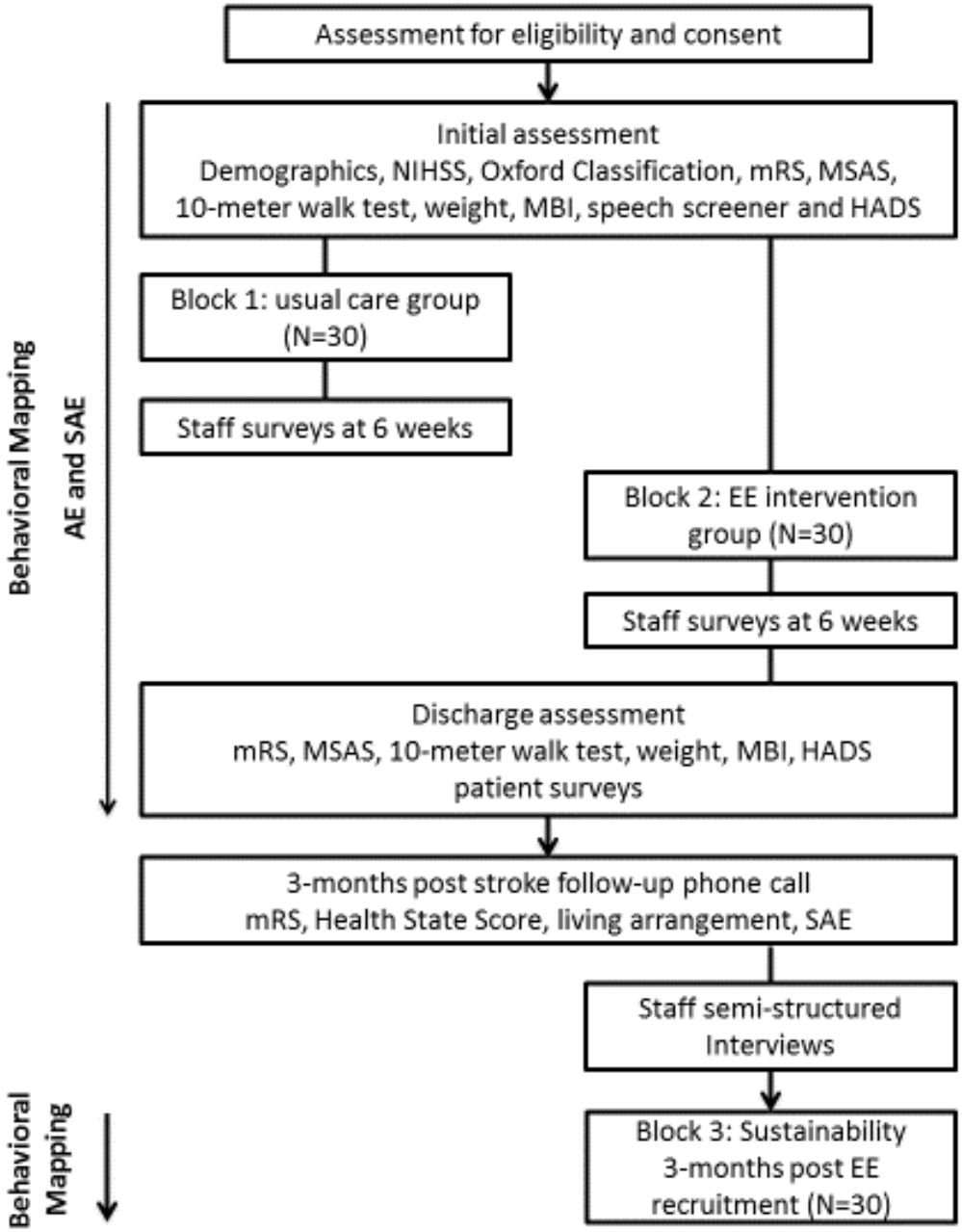

Figure 3-1 Flowchart of Study

NIHSS: National Institutes of Health Stroke Scale. mRS: modified Rankin Scale. MSAS: Mobility Scale for Acute Stroke. MBI: Modified Barthel Index. HADS: Hospital Anxiety and Depression Scale. EE: Enriched Environment. AE: Adverse Events. SAE: Serious Adverse Events.

3.3.7 Sample size and data analysis

3.3.7.1 Sample size

We performed a sample size calculation to ensure that this pilot study had sufficient power to determine significant positive effect on our primary outcome measure – total activity levels in stroke survivors. Estimates were based on data from a recent study of the effect of an enriched environment on activity levels conducted during inpatient stroke rehabilitation (Janssen et al., 2014b). This study reported a mean increase in the proportion of observations with 'any activity' in the experimental (enriched) group of 13% (SD 14) and the control (not enriched) group of 2% (SD 16.5), equivalent to an effect size of 0.719. We performed a one-sided, between-groups test as this past research had shown an enriched environment to increase activity levels in stroke survivors (Janssen et al., 2014b). Based on a rounded and conservative effect size of 0.7, we calculated that we needed to recruit 26 participants per group to detect one standard deviation difference between enriched environment and usual care groups for 'any activity' with an alpha level of 0.05, and a power of 0.8. Allowing for a conservative dropout rate of 12%, we aimed to recruit 30 participants per group.

3.3.7.2 Statistical analysis

Baseline characteristics of participants were described using means and standard deviations for continuous variables and counts and percentages for categorical variables. To address the primary outcome (change in activity levels for 'any activity') we compared the proportion of activity between usual care and enriched environment intervention group. Consistent with previous research, we assumed that at each observation the participant remained engaged in that activity for the entire 10-minute interval; this allowed us to calculate the proportion of time each group was engaged in 'any activity'. Subsequently, we explored for differences in each activity domain and subcategories within domains. Consistent with previous research in the field (Janssen et al., 2014b) unobserved and missing data was excluded from the analysis for the primary outcome of change in activity level. Total number of observations per participant was summed and used to calculate the proportion of observations each participant was observed to be engaged in 'any activity' (and physical, social and cognitive activity and other fields included in the data collection sheet). The difference in activity levels between groups was determined using one-way ANCOVA with group

as independent variable, activity levels as the dependent variable, and adjusting for covariates age (years), stroke severity (NIHSS), and premorbid function (mRS). To determine differences in secondary outcome measures between groups, one-way repeated-measures ANCOVA was performed for variables separately, adjusting for age (years), stroke severity (NIHSS), and premorbid function (mRS). We adjusted for the above covariates as these covariates impact on activity levels, functional outcomes and mood in stroke survivors (Bernhardt et al., 2004; Kutlubaev & Hackett, 2014; Quinn et al., 2017; Veerbeek et al., 2011).

3.4 Discussion

Research has consistently demonstrated that acute stroke unit care provides very limited opportunities for people with a stroke to be involved in physical activities and that patients are often alone. Increased activity levels after stroke are associated with better functional outcomes and reduced complication rates. In addition, with the ageing population and the rising incidence in stroke there is a strong need for the development of resource-efficient interventions that can improve patient and service outcomes without increasing staffing cost. The enriched environment is an innovative interdisciplinary model of care that could build the capacity of acute stroke teams to deliver efficient and effective care for people with stroke

Chapter 4 is adapted from the following publication
(Appendix 4 URL Link to Published Paper)

Embedding an enriched environment in an Acute Stroke Unit increases activity in people with stroke: A controlled before-after pilot study.

Rosbergen ICM, Grimley RS, Hayward KS, Walker KC, Rowley D, Campbell AM, McGufficke S, Robertson ST, Trinder J, Janssen H, Brauer SG.

Clinical Rehabilitation 2017;31(11):1516-28

and was presented at

Australian Physiotherapy Conference, Gold Coast Australia, October 2015

(Platform presentation)

European Stroke Organisation Conference, Glasgow Scotland, April 2015.

(Poster presentation)

World Congress of NeuroRehabilitation, Philadelphia, United states of America, May 2016
(Platform presentation)

Smart Strokes Conference, Canberra, Australia, August 2016.

(Platform presentation)

Australia Pacific Stroke Conference, Brisbane, Australia, July 2016.

(Platform presentation)

Australian Physiotherapy Association Conference, Sydney, Australia, October 2017

(Platform presentation)

Chapter 4 Study 1 Enriched environment in acute stroke

4.1 Abstract

Background: To determine whether an enriched environment embedded in an acute stroke unit can increase activity levels in acute stroke patients, and reduce adverse events.

Methods: A controlled before-after pilot study in an acute stroke unit in a regional Australian hospital. We recruited acute stroke patients admitted during a) initial usual care control period, and b) an enriched environment period. Usual care participants received usual one-on-one allied health intervention and nursing care. The enriched environment participants were provided stimulating resources, communal areas for eating and socialising, and daily group activities. Change management strategies were used to implement an enriched environment within existing staffing levels. Behavioural mapping was used to estimate patient activity levels across both groups. Participants were observed every 10-minutes between 7.30am and 7.30pm within the first 10-days after stroke. Adverse and serious adverse events were recorded using a clinical registry.

Results: The enriched environment group (n=30, mean age 76.7±12.1) spent a significantly higher proportion of their day engaged in 'any' activity (71% vs. 58%, p=0.005) compared to the usual care group (n=30, mean age 76.0±12.8). They were more active in physical (33% vs. 22%, p<0.001), social (40% vs. 29%, p=0.007) and cognitive domains (59% vs. 45%, p=0.002) and were less often in supine position (45% vs. 68%, p<0.001). The enriched group experienced significantly fewer adverse events (0.4±0.7 vs.1.3±1.6, p=0.001), with no differences found in serious adverse events (0.5±1.6 vs.1.0±2.0, p=0.309).

Conclusions: Embedding an enriched environment in an acute stroke unit increased activity in stroke patients and warrant further study to investigate the efficacy of an enriched environment on long term outcomes following stroke.

4.2 Background

Stroke patients who are in an acute stroke unit spend the majority of their day inactive and alone (Bernhardt et al., 2004; Mattlage et al., 2015; West & Bernhardt, 2012). Inactivity levels observed in hospitalised stroke patients range from 40% to 69% (West & Bernhardt, 2012), with more physical inactivity occurring within the first 14-days after stroke (West & Bernhardt, 2012). Time spent engaged in social and cognitive activity while in an acute stroke unit has yet to be determined, but is likely limited. Frequent engagement in physical activities early after stroke has shown to promote motor and functional recovery (Veerbeek et al., 2014). In addition, evidence has emerged to suggest that social and cognitive stimulation after stroke may enhance recovery (Kruithof et al., 2013; Magee et al., 2017). Interventions to increase physical, social and cognitive activity early after stroke should be developed in the acute setting.

An enriched environment is an intervention designed to facilitate activity in all these activity domains by creating a stimulating environment (Nithianantharajah & Hannan, 2006), see section 2.1.10. The enriched environment in animal studies refers to housing conditions that are designed to stimulate motor and sensory functions, as well as social and cognitive activity compared with standard housing (Nithianantharajah & Hannan, 2006). Rodents exposed to an enriched environment, which generally commences in the acute phase post stroke, perform superiorly in sensorimotor function, learning and memory compared to rodents not engaged in an enriched environment (Janssen et al., 2010; Ohlsson & Johansson, 1995). There is evidence of neurobiological changes underpinning these improvements including increased dendritic spine density and remodeling of cortical maps (Johansson, 2004; Nithianantharajah & Hannan, 2006).

To date, one study has translated an enriched environment model into a clinical environment with sub-acute stroke patients undergoing inpatient rehabilitation (Janssen et al., 2014b). Enrichment in this study included provision of stimulating equipment on the ward and at the patient bedside to promote activity. This study demonstrated that stroke patients undergoing enriched rehabilitation were 1.2 times more likely to engage in ‘any’ activity compared to stroke patients in a non-enriched rehabilitation setting (Janssen et al., 2014b). Qualitative exploration of this study identified that staff found it challenging to change work routine and implement enrichment strategies within their busy workdays (White et al., 2014). This suggests that change management strategies to support ward staff to incorporate enrichment strategies may be an important component of embedding an enriched environment.

Given stroke patients are consistently described as inactive and alone in acute stroke units, and that rodent models suggest benefit from exposure to enrichment 24-hours post stroke (Johansson & Ohlsson, 1996), the acute stroke unit environment appears to be an opportune setting to implement an enriched environment. Modifications to the previous enriched model (Janssen et al., 2014b) were implemented to facilitate the uptake of this intervention in the acute setting. Therefore, our primary aim was to determine if an enriched environment embedded in the acute stroke unit could increase 'any' activity, as well as physical, social and cognitive activity levels in stroke patients. Our secondary aims were to investigate the effect of an enriched environment on functional outcomes, adverse events, and length of stay.

4.3 Methodology

Detailed methodology for this study is provided in Chapter 3.

4.3.1 Design

This was a prospective, controlled before-after study in an acute stroke unit (Section 3.3.1). Behavioural mapping was used to compare activity levels of stroke patients treated within a usual care period with those treated following environmental enrichment.

4.3.2 Setting and participants

As described in detail in section 3.3.2 the study was conducted in the acute stroke unit of a regional Australian hospital. All stroke patients admitted to the acute stroke unit were screened for eligibility and consecutively enrolled. Eligibility criteria were described in 3.3.2.

Firstly, participants were recruited to the usual care control group. Immediately following this, the enriched environment was embedded in the acute stroke unit over a 6-week period. Subsequently, participants were recruited to the enriched environment group. Participants were informed that the study aimed to determine the effect of an alternative model of rehabilitation and were blinded to group allocation. Written informed consent was obtained from participants or their substitute decision maker.

4.3.3 Measures

4.3.3.1 Patient demographics

As detailed in section 3.3.3 an unblinded investigator collected baseline characteristics at entry to the study, which included demographic and stroke clinical features, estimated premorbid mRS and Oxfordshire Stroke Classification (Bamford et al., 1991). Stroke severity was classified according to the NIHSS (Briggs et al., 2001) on admission (or day 1 if thrombolysed): mild (<8), moderate (8-16) or severe (>16).

4.3.3.2 Primary outcome measures

As detailed in section 3.3.5 primary outcome measure activity levels was determined using a behavioural mapping protocol adapted from Janssen et al. (Janssen et al., 2012) that has demonstrated reliability of this approach (Bernhardt et al., 2004). Participants were observed for 1-minute at 10-minute intervals from 7.30am till 7.30pm on Tuesday, Thursday and Saturday, to a total maximum of three mapping days. All observations occurred within the first 10-days post stroke. Five behavioural mapping staff members received specific training in behavioural mapping, and mapping staff were consistent across all phases of the study and received no details regarding study design and study aims.

For each observation, the primary physical, social and cognitive activity performed was recorded, in addition to patient location, body position and people present. ‘Any activity’ was defined as the participant performing a physical, social or cognitive activity, or any combination of activities in these domains (Janssen et al., 2012).

When the observer was unable to view the participant due to activity that precluded direct observation (e.g. participant in the bathroom) an attempt was made to retrospectively estimate activity from attending staff or the participant. Intervals were classified as ‘unobserved’ when a participant was unable to be observed (e.g. off the ward for investigations) or activity was unable to be retrospectively estimated. Unintentional non-observations were classified as ‘missing data’. Total activity performed in each activity domain was expressed as a percentage of the total number of observations documented in each domain. (Appendix 10)

4.3.3.3 Secondary outcome measures

As detailed in section 3.3.6 an investigator collected secondary measures after enrolment to the study in the usual care and enriched group. A blinded assessor collected secondary measures within 24-hours of discharge from the stroke unit or when care was transferred to palliative intent. Secondary measures collected included functional outcomes, adverse and serious adverse events and mood. Functional outcomes included the mRS, Modified Barthel Index (MBI), 10-meter walk test and Mobility Scale for Acute Stroke patients (MSAS). Mood was assessed with the Hospital Anxiety and Depression Scale (HADS). SAE and AE were recorded and included falls, pneumonia, pressure areas, cardiac problems, seizures, reduced Glasgow Coma Scale, stroke, transient ischemic attack, urinary tract infection, depression, constipation, malnutrition, delirium, and "other" including shoulder pain, deep venous thrombosis and urinary retention (Goldfarb, 2012; Ostwald et al., 2013).

4.3.4 Intervention

The usual care group received usual acute stroke management per Australian clinical guidelines for stroke management (Stroke Foundation, 2010). After the usual care period a 6-week period was used to enable transformation of the acute stroke unit into an enriched environment after which recruitment for the enriched group was initiated. The enriched environment intervention focused on the following key strategies; 1) a stimulating environment was created including communal areas for mealtimes and group activities, and provision of stimulating resources in the ward and at the patient bedside; 2) patient and family involvement was encouraged through provision of information and a brochure, and 3) support to staff was provided to facilitate a change in clinical practice. This is detailed in section 3.3.4, Appendix 7, Appendix 8, and Appendix 9

Enriched environment strategies of mealtime occurrence, group sessions, availability of stimulating resources and delivery of information brochures were monitored during the enriched environment period. Staffing levels were monitored daily across groups. This is detailed in section 3.3.4.1

4.3.5 Sample size and statistical analysis

As detailed in section 3.3.7 we determined the sample size using data from a study of the effect of an enriched environment on activity conducted in the sub-acute inpatient rehabilitation setting (Janssen et al., 2014b). Sample size calculation determined that 26 participants per group were required to detect one standard deviation difference between the enriched environment group and usual care group for 'any activity' with an alpha level of 0.05, and a power of 0.8 (Rosbergen et al., 2016). Allowing for 15% potential dropouts, we aimed to recruit 30 participants in each group.

Data was analysed on an intention to treat basis. For the primary outcome a one-way ANCOVA was performed to determine difference in activity levels between groups adjusting for covariates of age, stroke severity (NIHSS) and premorbid mRS. We determined difference in activity levels for 'any activity' and for the subcategories physical, social and cognitive activity. We also determined total percentage spent in different positions, locations and people present with the participant. Consistent with previous research in this field, missing and unobserved data were excluded from the statistical analysis for the primary outcome (Janssen et al., 2014b). To confirm findings, we performed a sensitivity analysis whereby we repeated the analysis and included all missing and unobserved data, coded as 'no activity'.

To determine differences between the usual care and enriched environment group for secondary outcome measures of function, mood and anxiety at discharge, we performed one-way repeated measures ANCOVAs that were adjusted for age, stroke severity (NIHSS) and premorbid mRS. In addition, to determine differences for adverse events, length of stay within the stroke unit and Health Related Quality of Life at 3-months post stroke a one-way ANCOVA adjusted for age, stroke severity (NIHSS) and premorbid mRS was performed. Finally, a Mann-Whitney U-test was used to determine differences in modified Rankin Scale between usual care and enriched environment group at all time points. Participants who were unable to perform a test were excluded for that measure from statistical analysis. Statistics were performed using IBM SPSS Statistics for Macintosh version 24.0 (IBM Corp., Armonk, N.Y., USA) and significance was set at $p<0.05$.

4.4 Results

4.4.1 Demographics

Between 23rd of June 2014 and 14th of February 2015 (excluding the 6-week implementation period) 195 individuals with suspected stroke were assessed for eligibility and 62 participants were enrolled to the usual care and enriched environment group. This yielded a conversion rate of 32%. The main reason for exclusion (32%) was that the expected LOS was <2 days. See Figure 4.1 for the flow of participants.

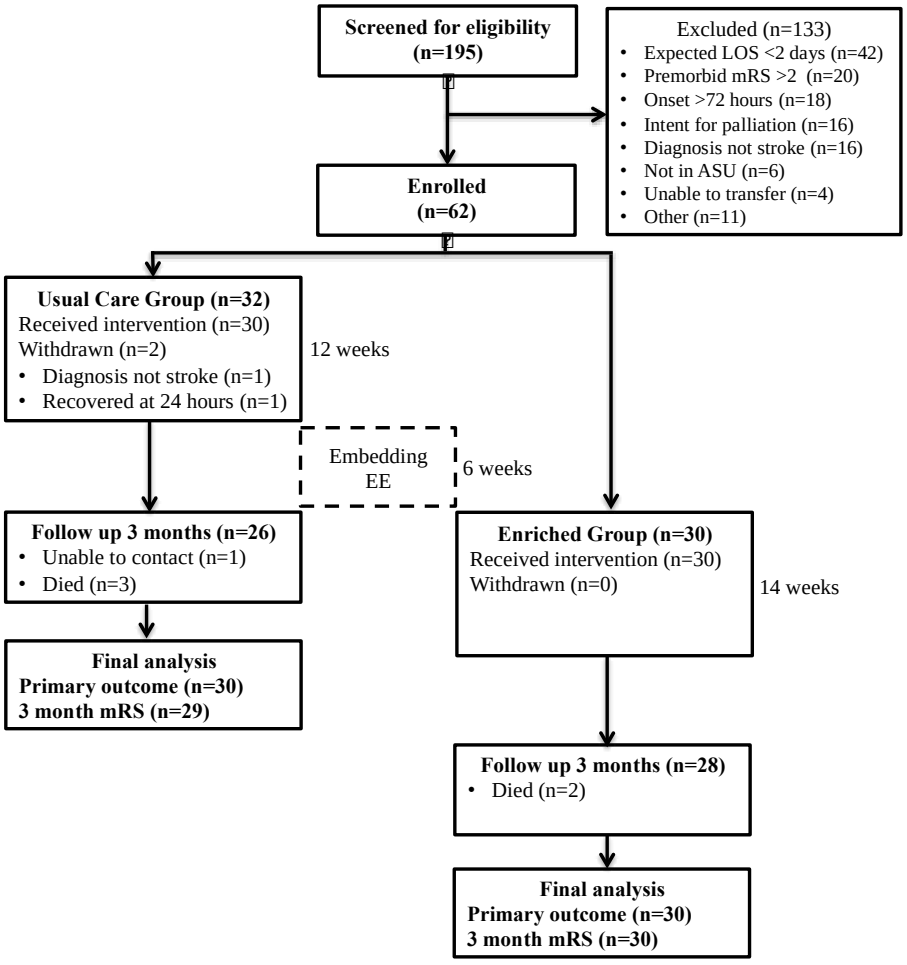

Figure 4-1 Flow of participants

There were no significant differences between groups across baseline characteristics (p>0.063 for all variables, see Table 4.1). On average participants were approximately 76 years, and experienced a left sided stroke (~60%) resulting in a mild stroke (~58%). The majority of participants were able

to follow three stage commands (~60%), and were living with others in the community prior to the stroke (~60%). A low proportion of observational data was unobserved (usual care 3.2%, enriched 2.6%) or missing (usual care 0.6%, enriched 0.2%).

Table 4-1 Characteristics of participants

Characteristics n (%) or mean (SD)	Usual care group (n=30)	Enriched group (n=30)
Age (years)	76.0 (12.8%)	76.7 (12.1)
Gender		
Male	17 (56.7%)	22 (73.3%)
Females	13 (43.3%)	8 (26.7%)
Premorbid mRS		
0	20 (66.7%)	14 (46.7%)
1	6 (20.0%)	4 (13.3%)
2	4 (13.3%)	12 (40.0%)
Affected hemisphere		
Left	20 (66.7%)	18 (60.0%)
Right	10 (33.3%)	12 (40.0%)
NIHSS	8.5 (6.4)	7.8 (5.8)
Stroke severity		
Mild	17 (56.7%)	18 (60.0%)
Moderate	9 (30.0%)	9 (30.0%)
Severe	4 (13.3%)	3 (10.0%)
Oxfordshire Stroke Classification		
TACI	5 (16.6%)	2 (6.7%)
PACI	8 (26.7%)	9 (30.0%)
LACI	8 (26.7%)	6 (20.0%)
POCI	6 (20.0%)	10 (33.3%)
ICH	3 (10.0%)	3 (10.0%)
Rt-PA treatment		
Yes	7 (23.3%)	4 (13.3%)
Speech commands		
Unable	2 (6.7%)	2 (6.7%)
One stage	2 (6.7%)	7 (23.3%)
Two stage	7 (23.3%)	1 (3.3%)
Three stage	18 (60.0%)	19 (63.3%)
Living arrangement		
Alone	13 (43.3%)	11 (36.7%)
With others	17 (56.7%)	19 (63.3%)
BM day post stroke	5.2 (1.7)	4.8 (1.4)

mRS: modified Rankin Scale. NIHSS: National Institute of Health Stroke Scale. rt-PA: recombinant tissue plasminogen activator. TACI: Total Anterior Circulation Infarct. PACI: Partial Anterior Circulation Infarct. LACI: Lacunar Infarct. POCI: Posterior Circulation Infarct. ICH: Intracerebral Haemorrhage. BM: Behavioural Mapping.

4.4.2 'Any', physical, social and cognitive activity levels

For the primary outcome of 'activity levels' the enriched group spent a significantly higher proportion of their day engaged in 'any activity' ($p=0.005$), as well as in physical, social and cognitive domains ($p<0.007$) compared with the usual care group. The enriched group also spent a significantly lower proportion of their day in a supine position ($p<0.001$), were less often alone ($p=0.035$) or in their room ($p<0.001$). Sensitivity analysis of data including unobserved and missing data (coded as 'no activity') also found higher activity levels for 'any activity' ($p=0.002$), as well as physical ($p<0.001$), social ($p=0.003$) and cognitive ($p<0.001$) activity in the enriched group. See Table 4.2.

Table 4-2 Behavioural mapping outcomes: mean participant activity levels, position, location and people present expressed as a % of total observations (SD), and mean (95% CI) differences between usual care and enriched group. *One-Way ANCOVA adjusted for covariates age, NIHSS and premorbid mRS

	Usual care n=30	Enriched n=30	Between group differences Mean (95% CI)* (Enriched –Usual care)
Any activity	57.8 (23.7)	70.7 (17.1)	12.9 (4.0 to 21.8)
Total physical activity	22.3 (10.1)	32.9 (11.9)	10.4 (5.2 to 15.5)
Total social activity	29.3 (14.3)	39.8 (15.0)	9.9 (2.8 to 16.9)
Total cognitive activity	44.7 (21.1)	59.3 (16.5)	14.5 (5.5 to 23.4)
Supine position	68.0 (16.7)	45.0 (22.0)	-21.3 (-31.7 to -11.0)
In room	94.5 (2.7)	78.9 (9.1)	-15.2 (-18.8 to -11.5)
Alone	58.9 (13.9)	51.0 (13.8)	-8.3 (-16.0 to -0.6)

NIHSS: National Institute of Health Stroke Scale. mRS: modified Rankin Scale

4.4.3 Functional outcomes and mood

Secondary outcomes were determined between the usual care and enriched group. No differences between groups were found for change in function, anxiety or depression scores between admission and discharge from the stroke unit. See Table 4.3.

Table 4-3 Secondary outcomes part I: mean (SD) or median* (IQR), mean (SD) differences within, and mean (95%CI) differences between usual care group and enriched group for all outcomes. **One-Way repeated measures ANCOVA adjusted for age, NIHSS and premorbid mRS.

	Usual care entry study	Enriched entry study	Usual care discharge	Enriched discharge	Within group differences Usual care (discharge- entry)	Within group difference Enriched (discharge- entry)	Between group difference Mean (95%CI)**
MSAS/36 (n=30)	20.1 (8.3)	22.9 (7.7)	26.0 (10.4)	28.4 (9.4)	5.9 (5.7)	5.4 (5.7)	0.6 (-2.4 to 3.5)
MBI /100 (n=30)	43.0 (26.9)	52.7 (22.9)	60.3 (34.8)	67.0 (32.3)	16.8 (17.9)	14.8 (17.9)	2.1 (-7.2 to 11.3)
mRS /6* (n=30)	5.0 (4.0-5.0)	4.0 (4.0-5.0)	4.0 (2.5-5.0)	4.0 (2.8-4.0)	-0.9 (0.8)	-0.8 (0.8)	-0.1 (-0.5 to 0.4)
HADS anxiety /21	n=28 6.1 (4.4)	n=24 4.2 (3.0)	n=28 5.7 (4.6)	n=24 4.0 (3.2)	n=28 -0.3 (4.2)	n=24 -0.4 (4.2)	-0.1 (-2.2 to 2.4)
HADS depression /21	n=28 4.2 (3.2)	n=24 4.7 (3.3)	n=28 5.6 (3.6)	n=24 3.9 (3.4)	n=28 1.3 (3.8)	n=24 -0.8 (3.8)	2.0 (-0.1 to 4.2)
10 meter walk (s)	n=6 16.9 (7.0)	n=8 11.9 (5.4)	n=6 13.5 (6.9)	n=8 9.4 (3.6)	n=6 -3.6 (2.6)	n=8 -2.3 (2.8)	-1.3 (-4.5 to 1.9)

MSAS: Mobility Scale for Acute Stroke. MBI: Modified Barthel Index. mRS: modified Rankin Scale. HADS: Hospital Anxiety and Depression Scale. NIHSS: National Institute of Health Stroke Scale.

4.4.4 Adverse events, serious adverse events, and 3-months follow up

Participants in the enriched group experienced significantly fewer adverse events (p=0.001) during their stay in the acute stroke unit. No differences between groups were found for serious adverse events (p=0.309). Types of experienced adverse events for both groups are listed in Appendix 11. Total length of stay within the acute stroke unit was significantly shorter for the enriched group compared to the usual care group (p=0.02). See Table 4.4.

Table 4-4 Secondary outcomes part II: Mean (SD) and mean (95% CI) differences between usual care and enriched group, and median (IQR) or mean (SD) of outcome measures at 3-months follow up. One-Way ANCOVA adjusted for covariates age, NIHSS and premorbid mRS

	Usual care	Enriched	Mean (95% CI) (Enriched – Usual care)
Intervention			
Participants experiencing AE, n	16	7	-
Registered AE, n	40	11	-
Mean AE per participant	1.3 (1.6)	0.4 (0.7)	-1.1 (-1.7 to -0.5)
Participants experiencing SAE, n	10	4	-
Registered SAE, n	30	16	-
Mean SAE, per participant	1.0 (2.0)	0.5 (1.6)	-0.5 (-1.4 to 0.5)
Length of Stay (days)	12.0 (7.4)	9.7 (5.7)	-3.4 (-6.3 to -0.6)
Three months follow up			
mRS/6	2.0 (1.0-4.0)	2.0 (1.0-3.0)	0.536*
EQ-VAS/ 100**	71.4 (20.9)	74.6 (22.9)	6.8 (-4.7 to 18.2)

NIHSS: National Institute of Health Stroke Scale. mRS: modified Rankin Scale. AE: Adverse Events. SAE: Serious Adverse Events. EQ-VAS: EuroQol Visual Analogue Scale. *=p-value Mann-Whitney U test. **n=24 for Usual care and n= 27 for Enriched group.

At 3-months there were no differences in mRS (p=0.536) and EQ-VAS (p=0.239) between the usual care group and enriched environment group. See Table 4.4

4.4.5 Fidelity

Monitoring of fidelity confirmed that all participants and/or families in the enriched group received an information brochure and stimulating resources were readily available in communal areas and at the bedside. During the enriched environment period all scheduled meal times occurred. Group sessions took place 78% of the time. The primary reason for not occurring was when 'appropriate' group composition was not available e.g. no participants with language or cognitive impairments. Staffing levels were consistent across the usual care and enriched environment period.

4.5 Discussion

This study found that embedding an enriched environment in an acute stroke unit had a significant positive effect on activity levels across all activity domains without increasing staffing levels. In addition to participants being more active, they were also more likely to be outside their room, with someone, and not in a supine position. Fewer participants in the enriched environment group experienced fewer adverse events, and length of stay was significantly shorter. Together, this suggests that enriching acute stroke units may promote increased activity levels in stroke patients early after stroke, which has been associated with improved functional outcomes in animal models (Janssen et al., 2010; Livingston-Thomas et al., 2016) and human populations after stroke (Glass et al., 1993; Veerbeek et al., 2014).

Results of this study are in line with positive effects found on activity levels in the enriched environment study completed in the sub-acute inpatient rehabilitation setting (Janssen et al., 2014b). In our acute stroke unit study, we observed that 'activity' levels were greater than previously observed in the sub-acute inpatient rehabilitation study. A possible explanation for observed differences is that we had made adaptations to the enriched environment intervention used in the sub-acute rehabilitation setting to suit our acute setting. In our acute setting, in addition to use of stimulating resources, we also changed the therapeutic environment and facilitated participant engagement. Specifically, participants were encouraged and assisted to participate in meal times and group sessions as the majority of our participants were mobility dependent (88%), and many relied on assistance to access stimulating equipment at the bedside. In contrast, the study in the inpatient rehabilitation setting mainly provided resources for stroke patients in the rehabilitation ward and at the bedside to enhance behaviour that was driven by the physical environment (Janssen et al., 2014b). Furthermore, we also actively involved caregivers to facilitate use of stimulating

resources inside and outside of therapy hours. The beneficial effect of caregiver involvement to increase compliance with self-directed activities has been reported in previous studies (Galvin et al., 2014; Harris et al., 2010).

Activity levels observed in our study can be compared with a study conducted in Norway that also used the environment and communal meals within usual care to encourage greater activity in stroke survivors (Askim et al., 2012). Stroke survivors in the Norwegian study were in bed less (30%) when compared to this Australian study (45%). There is variation between these two studies, which may contribute to the differences. This includes time to recruitment: the Norwegian study recruited patients till 14-days post stroke, whereas this study recruited patients within 72-hours post stroke and observed patients till 10-days post stroke. It is possible that participants who were recruited later post stroke in the Norwegian study showed higher activity levels. Furthermore, activity data in the Norwegian study was obtained on weekdays only between 8am and 5pm (Askim et al., 2012). Our study observed patients till 7.30pm, as well as on weekends, which afforded inclusion of activity during after hours, and time periods when no therapy staff were available. However, even with these differences noted, the study in Norway showed that stroke survivors do not have to be inactive post stroke, and that use of the stroke unit environment may positively contribute to greater activity levels in stroke survivors.

There are other possible contributing factors for observed higher activity levels in this study. We adapted the behavourial mapping protocol to suit an acute setting, which saw the inclusion of additional activities (e.g. active listening). Furthermore, a proportion of our participants were able to go home after discharge from the acute stroke unit (usual care 17% and enriched group 27%) indicating that these participants had a likely higher functional capacity at time of observations. This study showed no effect on functional measures between groups, in contrast to the study from Khan et al., which showed greater improvements in functional outcomes at discharge from the inpatients rehabilitation setting (total stroke participants Enriched n=28 and usual care n=25) (Khan et al., 2016). The lack of transfer from increased activity levels to improved functional outcomes could have a variety of possible explanations. Firstly, most functional measures were taken on ‘admission’ and ‘discharge’ from the acute stroke unit, which is a relative short time period to establish a difference between groups for functional recovery, in this case <12 days vs. mean duration 14 days (range 9-21 days) in Khan et al. In addition, functional recovery is affected by length of stay, which was shorter for the enriched environment group (enriched 9.7 days vs. usual care 12.0 days). Secondly, when we did measure follow up at 3-months post stroke, we only collected modified Rankin Scale, which is a 6-point ordinal scale measure of functional

independence. To examine changes in function, more sensitive measures should be considered in the future. Finally, the study was not powered to examine changes in function.

Mood and anxiety showed no differences between groups at discharge from the acute stroke unit. These results are in contrast with the results found in the Khan et al. enrichment study who found a significant reduction in depression and anxiety subscales in favour of the enriched group at discharge from the subacute rehabilitation setting (Khan et al., 2016). It should be noted that the participants in this study had depression and anxiety scores within the normal range for older adults (Hinz & Brahler, 2011), thus there may have been potential for little change. Nonetheless, it is possible that the longer period of time that stroke survivors were exposed to the enriched environment program in the subacute inpatients setting contributed to these results. In our study depression scores reduced in the enriched group between admission and discharge, while they increased in the control group, but this was not significant. Larger studies are needed to determine if environmental enrichment can impact on depression, anxiety and quality of life.

There were some general observations noted throughout the conduct of this study that warrant consideration in future enriched environment studies. Firstly, we noticed that some participants were not interested in group activities and/or communal mealtimes, preferring to stay in their room. In the majority of these cases, these participants still engaged in activity but remained at their bedside. This was afforded by the inclusion of stimulating resources and individualised activity cards located in their room. Further development of enrichment strategies are needed to ensure meaningful activity opportunities that are tailored to the needs and personality of each individual. Secondly, we encountered challenges with the delivery of individual intervention strategies during periods of staff rotations. Nurse champions and study team members would assist new staff with implementing enrichment strategies and encourage compliance, but it was noted that new staff members found it difficult to be compliant until they were more familiar with their new work environment. This has been reported as a challenge in previous implementation trials in stroke (McCluskey et al., 2016). Taken together, these observations highlight areas for attention in future implementation trials in order to promote efficacy and long-term sustainability of an enriched environment.

Strengths of our study are the demonstration of successful implementation of an enriched environment with increased activity levels within the busy environment of an acute stroke unit, where in general patients are more unwell than in rehabilitation settings. The significant increase in activity levels in stroke patients suggests that it is possible to empower the acute stroke team to increase activity levels in stroke patients within existing staffing levels. However, there were limitations to this pilot study. Our study had a small sample size with 30 participants in each cohort

and the intervention was conducted in one center. Furthermore, as our study used a before-after design, cohorts were treated at different times in our unit. Changes over time such as change in staff or health policies may have impacted on results. A randomised control trial design would add power, but as the intervention was at a ward level, this would require a multi-site approach such as a cluster randomised control trial or stepped wedge design. Finally, observation of behaviour as a data collection method may have affected participants and staff to change behaviour in response to being observed. We minimised this limitation utilising similar behavioural mapping methods across all groups and the study was conducted over a prolonged time period.

Finally, there are still many uncertainties about optimal circumstances for implementing an enriched environment in an acute stroke unit. Questions such as influence of hospital design (Devlin & Arneill, 2003), and the role of staff culture (Lok et al., 2011) in successful implementation remain unknown. Nevertheless, the results demonstrated in this study are promising and provide the foundation for larger studies in a variety of acute stroke units to explore the generalisation of these findings. Examining cumulative benefit derived by stroke patients who flow through environmental enrichment in both acute and subacute rehabilitation phases would add value in determining the impact of an enriched environment on adverse events, depression and functional outcomes along the continuum of stroke recovery.

4.6 Conclusion

Embedding an enriched environment in an acute stroke unit is attainable within existing staffing levels and may increase physical, social and cognitive activity levels in individuals with stroke in the acute clinical setting.

Chapter 5 is adapted from the following publication and published abstract
(Appendix 4 URL Link to Published Paper)

Embedding an enriched environment in an Acute Stroke Unit increases activity in people with stroke: A controlled before-after pilot study.

Rosbergen ICM, Grimley RS, Hayward KS, Walker KC, Rowley D, Campbell AM, McGufficke S, Robertson ST, Trinder J, Janssen H, Brauer SG.

Clinical Rehabilitation 2017;31(11):1516-28

And

Are the effects of an enriched environment on patient activity sustained over time in an acute stroke unit?

Rosbergen I, Grimley RS, Hayward KS, Walker KC, Rowley D, Campbell AM, McGufficke S, Roberston ST, Trinder J, Janssen H, Brauer SG.

International Journal of Stroke 2017, Vol. 12(3S) 10

and presented at

Scientific Meeting of the Stroke Society of Australasia, August 2017. Queenstown, New Zealand

(Platform presentation)

Chapter 5 Study 2 Sustainability of an enriched environment

5.1 Abstract

Background: Sustainability of an enriched environment beyond a clinical trial has not yet been investigated. This study determined if increased activity levels were sustained in a new cohort of stroke survivors admitted 3-months post conclusion of an enriched environment.

Methods: Stroke patients in an acute stroke unit were recruited to a sustainability group 3-months following completion of a controlled before-after pilot study where enriched environment was the intervention. The enrichment model in the pilot study incorporated stimulating resources, communal areas for eating and socialising, and daily group activities. Change management strategies were used to support staff to deliver the intervention. At intervention completion, the enrichment model was maintained, but change management strategies were withdrawn. Behavioural mapping was used in the enrichment and sustainability phase to estimate patient activity levels, body position, location and people present. Participants were observed every 10-minutes between 7.30am and 7.30pm within the first 10-days after stroke.

Results: The sustainability group (n=30, mean age 73.8±17.4) showed no difference in proportion of time spent in 'any' ($p=0.120$), physical ($p=0.114$), social ($p=0.56$) or cognitive ($p= 0.124$) activity compared to the enriched environment group (n=30, mean age 76.7±12.1). However, the sustainability group were more often in a 'supine position' ($p<0.001$) or in their room ($p=0.001$) compared to the enriched group. Time spent 'being alone' was unchanged ($p=0.120$).

Conclusion: The effect of an enriched environment on patient activity levels was sustained 6-months post implementation. However, patients returned to spending more time in bed in their room. Prolonged use of change management strategies that support staff to maintain new work routines may be essential to successfully modify patient behaviour long term.

5.2 Background

Once a new intervention has been embedded in the clinical setting it raises the question ‘how to sustain new clinical practice?’ Many new trialled interventions have shown that it is difficult to maintain change beyond the initial pilot study (Virani et al., 2009). Sustainable change refers to a continuation of the introduced clinical program, and core elements over time after initial supports have been withdrawn (McCluskey & O'Connor, 2017; Virani et al., 2009). Factors reported to limit sustainability of changed clinical practice include insufficient attention to continued staff training (Wallin et al., 2005), and limited exploration of barriers and facilitators to the new intervention (Hagedorn et al., 2006). Contextual factors such as leadership that support a culture of evidence based practice, and infrastructure also promote sustainability of an intervention (Stetler, 2003). There is limited literature at present to suggest that sustaining clinical practice over years may be promoted through adaptation of the intervention to the specific context, education, leadership and financial support (McCluskey & O'Connor, 2017).

In the initial pilot study aimed at embedding an enriched environment in the acute stroke unit (Chapter 4) deliberate efforts were made to include a wide variety of change management strategies to support staff in changing their clinical practice (Chapter 3, and Appendix 7). A complex intervention such as an enriched environment requires a change in clinical routine and greater collaboration between disciplines, which has an effect on all staff working in an acute stroke unit. To promote a change in practice, several strategies were built into our intervention protocol and employed throughout the study duration, including identification of barriers and facilitators, small interactive educational workshops, nurse champions, reminders on the ward, frequent newsletters and inclusion of key opinion leaders (Grol & Grimshaw, 2003; McCluskey & O'Connor, 2017). These implementation strategies have been previously successfully adopted in implementation of a complex nursing protocol across acute stroke units (Middleton et al., 2011). The logical next step was to determine if these investments in supporting staff to implement an enriched environment resulted in continued change in clinical practice in the acute stroke unit. Thus, the aim of this study was to investigate if the effect of the enriched environment intervention on increased activity levels was sustained 6-months after commencement of the enriched environment.

5.3 Methodology

5.3.1 Design

This was a prospective, controlled before-after study design with a follow up group. Sustainability of the enriched environment model was measured in a follow up group (referred to as sustainability group) recruited 6-months after commencement of environmental enrichment in the acute stroke unit (3-months post conclusion). Behavioural mapping was used to compare activity levels of stroke patients in the enriched environment group (intervention) with stroke patients in the sustainability group (follow up).

5.3.2 Setting and participants

The study was conducted in the same acute stroke unit of a regional Australian hospital. The staff, location and physical layout of the ward did not change between intervention and sustainability data collection. Three months following completion of the enriched environment group (and 6-months after commencing the enriched environment) we recruited participants to the sustainability group. All stroke patients admitted to the acute stroke unit were screened for eligibility and consecutively enrolled. The same eligibility criteria were used as previously detailed in section 3.3.2. Participants were informed that the study aimed to determine the effect of an alternative model of rehabilitation and were blind to group allocation. Written informed consent was obtained from participants or their substitute decision maker.

5.3.3 Measures

5.3.3.1 Demographics

An investigator collected baseline characteristics at entry to the study. This included demographic and stroke clinical features, estimated premorbid mRS and Oxfordshire Stroke Classification (Bamford et al., 1991). Stroke severity was classified according to the NIHSS (Briggs et al., 2001) on admission (or day 1 if thrombolysed): mild (<8), moderate (8-16) or severe (>16).

5.3.3.2 Sustainability of primary outcome

Our primary outcome measure was activity, determined using a behavioural mapping protocol adapted from Janssen et al. (Janssen et al., 2012), which is largely consistent with previous research in this field (Bernhardt et al., 2004; Janssen et al., 2014b; Mackey et al., 1996), and has been demonstrated to be a reliable approach (Bernhardt et al., 2004). Participants in the enriched environment and sustainability groups were observed for 1-minute at 10-minute intervals from 7.30am till 7.30pm. Behavioural mapping in the enriched environment group occurred on Tuesday, Thursday and Saturday, to a total maximum of three mapping days or until discharge from the acute stroke unit. Behavioural mapping in the sustainability group occurred across one randomly chosen Tuesday, Thursday or Saturday. All observations occurred within the first 10-days post stroke. Mapping staff were consistent across all phases of the study and received no details regarding study design and study aims. Further details regarding behavioural mapping have been discussed in section 3.3.5 and Appendix 10.

5.3.3.3 Enriched environment intervention

The enriched environment intervention created a stimulating ward environment and has been previously detailed in section 3.3.4 and appendix 7. In brief, public areas in the stroke unit were transformed to communal areas where participants had access to a variety of equipment. The therapeutic environment was changed to include daily group sessions with a focus on different aspects of stroke recovery such as stroke education, emotional support, communication and physical activities. On weekdays, AHAs facilitated under guidance from therapists communal breakfast and lunch to stimulate frequency of mobilisation and social interaction. In addition to creating a stimulating ward environment, participants and families received a written information brochure that emphasised the importance of activity, and how families could be involved to encourage activities out of therapy hours. All intervention strategies were implemented without changes in staffing levels. During the intervention phase, change management strategies were used to facilitate staff involvement in enrichment strategies. Key staff members including therapists, nursing staff and medical specialists of the acute stroke team were utilised as local opinion leaders to assist development and implementation of the enriched environment intervention. Further intervention and change management strategies details have been described in paragraph 3.3.4

5.3.3.4 Sustainability

After completion of the enriched environment period in the pilot study we maintained the therapeutic and physical environment in the acute stroke unit. Therapists and AHAs were informed to continue with communal meal times and daily group activities, and all stimulating resources were maintained in the acute stroke unit. All staff members were informed that the enriched acute stroke unit environment would be sustained as positive feedback was received from patients and families, and that continuation was supported by the leading stroke physician, nursing leaders, and senior allied health staff despite cessation of the trial. However, implementation strategies to support staff in continuation of their new work practice were withdrawn. This included cessation of change management strategies such as education sessions, reminders and newsletters, and nurse champions were informed that the pilot study had completed recruitment. To minimise any potential for altered staffing levels to confound the result of the sustainability group, staffing levels were monitored daily in the sustainability period to ensure consistency with prior recruitment periods. We did not monitor individual staff adherence to continuation of implementing enrichment strategies. Neither the study aim nor the timing of the sustainability period was communicated with staff.

5.3.3.5 Statistical analysis

Data was analysed on an intention to treat basis. For the outcome ‘activity levels’ a one-way ANCOVA was performed to determine difference in activity levels between the enriched environment (intervention) and sustainability (follow up) groups adjusting for covariates of age, stroke severity (NIHSS) and premorbid mRS. We determined difference in activity levels for ‘any activity’ and for the subcategories physical, social and cognitive activity. We also determined total percentage of observations spent in different positions, locations and people present with the participant. Consistent with previous research in this field and Chapter 4 analysis, missing and unobserved data were excluded from the statistical analysis for the primary outcome (Janssen et al., 2014b).

5.4 Results

5.4.1 Demographics

We recruited 30 participants to the enriched environment group between 27th of October 2014 and 14th of February 2015 (no recruitment occurred during the two weeks Christmas period from 22nd of December 2014 till the 4th of January 2015). We then recruited 31 participants to the sustainability group from 5th of May 2015 till 11th of June 2015. See Figure 5.1 for the flow of participants for all three recruitment groups in the study.

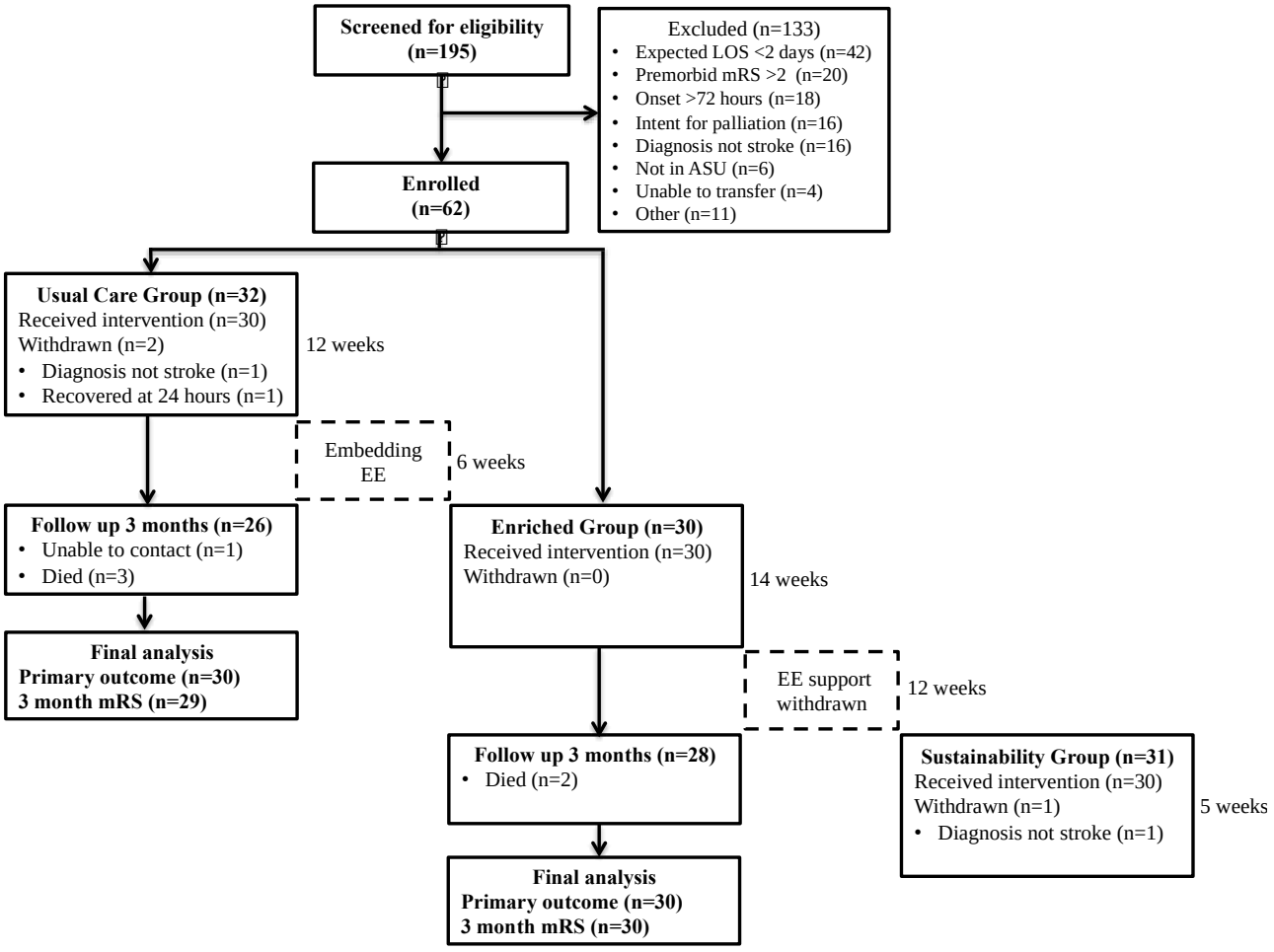

Figure 5-1 Flow of participants for usual care, enriched and sustainability group

There were no significant differences between groups across baseline characteristics ($p>0.182$ for all variables, see Table 5.1). A low proportion of observational data was unobserved (enriched 2.6%, sustainability 3.3%) or missing (enriched 0.2%, sustainability 1.8%).

Table 5-1 Characteristics of participants

Characteristics n (%) or mean (SD)	Enriched group (n=30)	Sustainability group (n=30)
Age (years)	76.7 (12.1)	73.8 (17.4)
Gender		
Male	22 (73.3%)	17 (56.7%)
Females	8 (26.7%)	13 (43.3%)
Premorbid mRS		
0	14 (46.7%)	15 (50.0%)
1	4 (13.3%)	5 (16.7%)
2	12 (40.0%)	10 (33.3%)
Affected Hemisphere		
Left	18 (60.0%)	17 (56.7%)
Right	12 (40.0%)	13 (43.3%)
NIHSS	7.8 (5.8)	7.0 (4.8)
Stroke severity		
Mild	18 (60.0%)	21 (70.0%)
Moderate	9 (30.0%)	6 (20.0%)
Severe	3 (10.0%)	3 (10.0%)
Oxfordshire Stroke Classification		
TACI	2 (6.7%)	2 (6.7%)
PACI	9 (30.0%)	13 (43.3%)
LACI	6 (20.0%)	4 (13.3%)
POCI	10 (33.3%)	6 (20.0%)
ICH	3 (10.0%)	5 (16.7%)
Rt-PA treatment		
Yes	4 (13.3%)	4 (13.3%)
Living arrangement		
Alone	11 (36.7%)	8 (26.7%)
With others	19 (63.3%)	22 (73.3%)
BM day post stroke	4.8 (1.4)	4.7 (1.7)

mRS: modified Rankin Scale. NIHSS: National Institute of Health Stroke Scale. rt-PA: recombinant tissue plasminogen activator. TACI: Total Anterior Circulation Infarct. PACI: Partial Anterior Circulation Infarct. LACI: Lacunar Infarct. POCI: Posterior Circulation Infarct. ICH: Intracerebral Haemorrhage. BM: Behavioural Mapping.

5.4.2 Sustainability of primary outcome

The sustainability group showed no difference in activity levels for ‘any activity’ ($p=0.120$) and for physical, social, and cognitive activity domains ($p>0.056$) compared with the enriched group indicating that activity levels were sustained (see Table 5.2). A significant difference was found for supine position ($p=0.001$) and location ($p<0.001$) showing no sustained effect i.e. in the sustainability period participants were showing a greater percentage of observations spent in a

supine position and in their room. There was no difference between groups for people present (p=0.194). See Table 5.2.

Table 5-2 Behavioural mapping outcomes: mean participant activity levels, position, location and people present expressed as a % of total observations (SD), and mean (95% CI) differences between enriched and sustainability group. *One-Way ANCOVA adjusted for covariates age, NIHSS and premorbid mRS

	Enriched n=30	Sustainability n=30	Between group differences Mean (95% CI)* (Sustainability - Enriched)
Any Activity	70.7 (17.1)	65.7 (22.6)	-7.4 (-16.8 to 2.0)
Total physical activity	32.9 (11.9)	28.9 (15.4)	-5.3 (-12.0 to 1.3)
Total social activity	39.8 (15.0)	33.7 (18.0)	-7.9 (-15.9 to 0.2)
Total cognitive activity	59.3 (16.5)	54.2 (23.2)	-7.5 (-17.0 to 2.1)
Supine position	45.0 (22.0)	63.8 (24.3)	20.2 (8.7 to 31.8)
In room	78.9 (9.1)	89.3 (8.0)	10.7 (6.2 to 15.2)
Alone	51.0 (13.8)	56.6 (21.3)	5.9 (-3.1 to 14.8)

NIHSS: National Institute of Health Stroke Scale. mRS: modified Rankin Scale.

5.4.3 Fidelity

Allied health staffing levels were monitored daily as they were crucial for mealtimes and group activities. When allied health staff were not present in the acute stroke on a certain day due to shortage of these health professionals elsewhere in the hospital this was captured. We found that allied health staffing levels were reduced during the sustainability period due to overall shortage of staff across the hospital limiting their availability for treatment and group activities in the acute stroke unit: speech therapists 1.0FTE enriched period vs. 0.8FTE sustainability period; dietitian 0.5FTE vs. 0.4FTE and occupational therapists 1.6FTE vs. 1.4FTE. There was no difference for physiotherapy, nursing or medical staff between enriched and sustainability periods.

5.5 Discussion

Study 1 in Chapter 4 showed that embedding an enriched environment in an acute stroke unit significantly increased activity levels across all activity domains in people with stroke without increasing staffing levels. This study investigating sustainability demonstrated that 'any', physical, social and cognitive activity levels were maintained in the sustainability group, showing that the intervention was sustained at a ward level. However, mean differences showed a reduction particularly in social activities, which indicated that activity levels appear to have a trend towards declining. In addition, improvements in body position and location achieved in the enrichment phase were not maintained during the sustainability period suggesting a relapse in clinical practice.

The sustainability group of the study aimed to determine if staff sustained their new clinical practice after withdrawal of change management strategies. The enriched environment intervention required a commitment from staff to deliver a complex intervention that needed strong collaboration between different health professionals, patients and carers. After completion of the enriched environment period staff members were not informed about results of the enriched environment intervention study. Furthermore, staff were instructed that the enriched environment intervention in the acute stroke unit was going to be continued based on positive patient, family and staff feedback. Implementing a complex intervention requires a thorough evaluation process, continuous education, and feedback response to individual staff to facilitate sustainability of an intervention. The process of feedback, education and staff involvement has previously been shown to promote compliance in a study that explored how to increase uptake of clinical guidelines in stroke rehabilitation (Vratsistas-Curto et al., 2017). The lack of process evaluation, education and feedback to individual staff members after completion of the enriched environment period likely contributed to a relapse in patients spending more time in bed and in their room (Moore et al., 2015). Thus, it is promising that even without a thorough feedback process to staff patient activity levels were sustained 6-months post implementation of embedding the enriched environment. However, these measures are critical for investigations moving forward. We need to understand the optimal frequency of education, feedback and evaluation to maintain optimal alignment with environmental enrichment principles.

The embedded enriched environment is at present an innovative intervention with limited evidence of effect on functional outcomes in stroke survivors. Competing clinical priorities and provision of care and therapy that are supported by strong clinical evidence may have caused reduced staff emphasis on the enriched environment intervention, which may have resulted in reduced sustainability of the intervention (Brady et al., 2011). It is possible that individuals may

have demonstrated greater compliance in sustaining practice if the enriched environment was supported by high-level evidence. In addition, sustainability of a new innovative intervention could be enhanced if stronger hierarchical control was shown through formal approval of the intervention at critical meetings, and when efforts were made to continuously support staff in managing competing priorities, shortage of staff and resources (Ilott et al., 2016).

A previous study explored experiences and perceptions of staff involved in a large research trial and showed that staff sustained focus and clinical practice of the delivered experimental intervention when they 'believed' the intervention promoted stroke recovery (Luker et al., 2016). A similar 'belief' process may have occurred in our study, where individual staff members that believed in the enriched environment intervention as beneficial for patients' recovery, maintained their new clinical practice. It was clear in previous qualitative work that there was a shift in staff perceptions about what benefits were derived from an enriched environment. The impact of staff perceptions in this program of work will be further explored in Chapter 7.

Factors from a team and organisational level that need to be considered in sustaining activity levels are team performance and hospital characteristics. A systematic review including qualitative studies that investigated contextual factors in high performing hospitals showed that positive interdisciplinary teamwork, leadership, expertise-driven practice and positive hospital culture contributed to high performance in hospitals (Taylor et al., 2015). Teamwork, leadership, expertise-driven practice and positive hospital culture may have contributed to sustained patient activity levels in this study. However, these impacting team and organisational factors were not investigated and future studies exploring the role of contextual elements on sustaining new clinical practice is recommended. Exploration of team and organisational factors is frequently missing in stroke research and are critical elements that need to be considered in the future.

Lastly, to effectively sustain complex interventions evidence recommend to prolong implementation strategies such as feedback and reminders over time (Johnson & May, 2015). We withdrew all staff support after the enriched environment intervention period. The observed decline in patient activity levels suggests that withdrawal of staff support occurred too early and staff had not consolidated their new routine. In addition, reduced allied health staffing in the sustainability period may have adversely impacted on maintaining effects, as well as the nature of hospitals to rotate staff, resulting in new staff who had not been educated regarding the rationale for and implementation of the enriched environment intervention.

Limitations of the study included that fidelity of the intervention was only monitored for staffing levels while occurrence of mealtimes, group sessions and provision of information brochure

was not captured for the sustainability group. In addition, the study was conducted at different time periods of the year, which may have impacted on results e.g. reduced therapy staff in the sustainability period that may have increased workload in remaining therapists, therefore limiting time available for enrichment strategies. Lastly, observational data in the sustainability group was only captured on one day while up to three days of observations were included in the intervention group, which may have biased the results as more observations were captured in the before-after study. A strength of this study design was the inclusion of a sustainability follow up group. Given few pilot studies investigated prolonged effect of an intervention, our design provided valuable information about how sustainability of a new intervention may be enhanced, and provided critical knowledge that will inform next stages of research into environmental enrichment in a clinical setting for stroke.

5.6 Conclusion

An enriched environment showed to increase activity levels in stroke patients in an acute stroke unit, and these higher activity levels were sustained 6-months post implementation. While not significant, there was a declining trend observed in patient activity levels, and patients did demonstrate a significant return to spending more time in bed in their room. This suggests that prolonged use of change management strategies to support staff may be critical to maintain new work routines and to successfully modify patient behaviour. Investigating sustainability of new interventions is recommended to determine if effects are maintained post initial pilot study as limited evidence is currently available.

Chapter 6 will describe the impact of an enriched environment on timing and nature of patient activities undertaken in an acute stroke unit

Chapter 6 Study 3 Timing and nature of patient activities

6.1 Abstract

Background: Clinical translation of an enriched environment within an acute stroke unit can lead to increased physical, social and cognitive activity levels of stroke patients. We aimed to understand how the enriched environment model impacted on the timing and nature of patient activities compared to the control environment, and to determine amount of staff assistance provided to facilitate patient activity.

Methods: An exploratory subanalysis of data collected within a before-after observational study in an acute stroke unit was performed. The enriched environment model incorporated stimulating resources, communal areas for eating and socialising, and group activities. Participants and families were encouraged to spend time away from the bedside and engage in activities outside therapy hours. The control group received standard care, which was largely delivered in the participants' bedroom. Participants were observed every 10 minutes between 7.30am and 7.30pm on weekday and weekends using a behavioural mapping technique to estimate activity levels. We compared activity levels during specified time periods, as well as the nature of activities observed, and amount of staff assistance provided during activities within each group. A one-way ANCOVA adjusted for age, stroke severity (NIHSS) and premorbid function (mRS) was performed.

Results: Higher activity levels in the enriched group occurred during scheduled communal activity periods ($p<0.001$), weekday non-scheduled activity periods ($p=0.007$), and weekend periods ($p=0.018$); but no difference was observed on weekdays after 5pm ($p=0.324$) when compared to the control group. The enriched group spent more time on upper limb tasks ($p<0.001$), communal socialising ($p<0.001$), listening ($p<0.007$) and iPad activities ($p=0.002$) when compared to the control group. No difference in staff assistance was observed to facilitate activities between groups ($p=0.055$).

Conclusion: Participant engagement in scheduled communal activities and environmental resources appeared to be major contributors to the greater activity that occurred within an enriched acute stroke unit. This knowledge is critical to inform future studies of an enriched environment, especially when upscaling across multiple sites.

6.2 Background

In our pilot study, we implemented an enriched environment model in an acute stroke unit and demonstrated an increase in patient's physical, social and cognitive activity levels compared to no enrichment (Rosbergen et al., 2017). Our environmental enrichment approach included access to communal areas and resources throughout the ward to promote time away from the bedroom, social interaction and sensory stimulation such as music, food aroma and art displays. Our enrichment model aligned with animal models of enrichment (Jeffers & Corbett, 2018; Nithianantharajah & Hannan, 2006) by stimulation of patients to explore different locations within and outside the ward, providing explicit physical, sensory and cognitive stimulation, and enabling opportunities to engage in social interactions with people such as other patients and families. In addition, scheduled group activities and communal mealtimes aligned with animal models of enrichment, as these activities ensured complex and novel stimulating situations such as complex group communication (Nithianantharajah & Hannan, 2006). The variety of stimulating equipment available throughout the unit and at the patient bedside aligned with 'various objects to explore' in animal models (Jeffers & Corbett, 2018) to enable sensory, motor, and cognitive stimulation. At present it is unknown how these embedded components of environmental enrichment contributed to increased activity in the acute stroke unit.

Given our model was effective in increasing activity we sought to understand how this change occurred. It is important to determine whether environmental enrichment increased activity outside of therapy hours, such as during evenings and weekends, as previous research has shown that patients are less active on weekends in inpatients clinical settings after stroke (King et al., 2011). Further, the enriched environment included scheduled communal activities (mealtimes and group activities) so it is important to examine if these activities were effective in increasing physical, social and cognitive activities early after stroke. In addition, implementing an enriched environment model in an acute stroke setting can positively or negatively impact the nature of activities performed by patients. For example, a greater time spent walking may be considered favourable, whereas prolonged time spent watching television may be viewed as a negative result of enrichment (Stamatakis et al., 2011). Encouragement of family involvement through information, brochures and self-directed exercise programs may have demonstrated higher activity levels in patients (Harris et al., 2009), but previous research also has highlighted that family involvement can be challenging when families have competing duties e.g. work (Galvin et al., 2008). Finally, as patients in the acute phase after stroke are frequently dependent on staff assistance for activities (Nursiswati et al., 2017), understanding how any increase in activity relied on staff assistance is an

important consideration for long-term sustainability and future widespread implementation of enrichment.

One study in the inpatient subacute stroke clinical setting has demonstrated that an enriched environment can increase patient activity prior to the study in this thesis (Janssen et al., 2014b; Rosbergen et al., 2017). However, little is known about the contributors to the impact of an enriched environment on patient activity. As such, our aims were to explore how the implemented enrichment model in an acute stroke unit had an effect on timing and nature of patient activities promoted by the enriched compared to control environment, and determine the amount of staff assistance provided during patient activities.

6.3 Methodology

This is a sub-study of a prospective controlled before-after observational pilot study. The pilot study received ethical approvals from all relevant authorities, and was conducted in accordance with the declaration of Helsinki. Methods of the pilot study were reported in Chapter 3.3 of this thesis and are briefly reviewed below.

6.3.1 Design and participants

The study was conducted in a 16-bed acute stroke unit in a regional Australian Hospital, which provided stroke care per Australian National Clinical Stroke Guidelines (Stroke Foundation, 2010). Stroke patients admitted to the unit were screened and consecutively enrolled when eligibility criteria were met (see section 3.3.2).

6.3.2 Intervention

6.3.2.1 Control intervention

The control group received nursing care and rehabilitation that was largely provided at the patient bedside. Physiotherapy, occupational therapy and speech therapy was provided in a one-on-one

approach, and participants received approximately 1-hour of therapy daily across these disciplines. Discipline specific AHAs supported therapists when participants required assistance from 2 persons for therapeutic interventions, and delivered additional individual therapy sessions to participants at the therapist's discretion.

6.3.2.2 Enriched environment intervention

To build the enriched environment, we transformed public areas in the acute stroke unit to communal seating areas for patients and families, and encouraged participants and families to spent time away from the bedside. Stimulating equipment (such as iPads loaded with therapy apps, music, books, newspapers, art, games, puzzles and magazines) were distributed throughout communal areas and at the patient bedside, which were accessible to participants 24-hours a day.

The enriched environment started 'scheduled communal activity' including breakfast (7am-8am), lunch (12pm-1pm) and group activities (2.30pm-4pm) on weekdays to provide regular activity opportunities spread across the day, representing in total 3.5 hours. Group activities had a strong multidisciplinary emphasis. On two weekdays, group activities focused on 'physical activities' including balance and ambulation, while on Tuesday 'support and stroke education', Wednesday 'communication enhancement', and Thursday 'upper limb and cognitive activities' respectively were provided. Participants were encouraged to participate in scheduled communal activities. 'Weekday non-scheduled activity' included all time outside the 'scheduled communal activity' between 8am till 5pm, representing in total 6,5 hours, with rest time encouraged between 1pm and 2pm. During non-scheduled activity time allied health staff performed their usual assessment and treatment, and usual nursing care was delivered.

Patient and family involvement was emphasised throughout the enrichment model. Participants and families received an information brochure explaining benefits of activity after stroke, as well as how participants and families could enhance activity to support their recovery. Therapists provided participants with self-directed activities as applicable to encourage independent self-practice outside therapy hours. Outside therapy hours were defined as time spent after 5pm or during weekends.

6.3.3 Data collection

Demographical and clinical data were collected at enrolment and have been outlined previously in section 3.3.3.

Behavioural mapping was used to define timing and nature of patient activity using a behavioural mapping protocol adapted from Janssen et al. (Janssen et al., 2014a). Behavioural mapping details have been described in section 3.3.5. To determine timing of activity we defined various time periods of interest: 1) weekday scheduled communal activity including 7am-8am (breakfast), 12pm-1pm (lunch), and 2.30pm-4pm (group), total time period 3.5 hours; 2) weekday non-scheduled activity including 8am-12pm, 1pm-2.30pm, and 4pm till 5pm, total time period 6.5 hours; 3) weekday >5pm-7.30pm, total time period 2.5 hours, and 4) weekend day 7.30am-7.30pm, total time period 12 hours.

Nature of activities were described in the behavioural mapping protocol in section 3.3.5 and Table 3.1 and appendix 10, which provides details of listed activities under each activity domain, as well as explanations for different locations, body positions, and people present. The listed activities are derived from the behavioural mapping protocol from Janssen et al. (Janssen et al., 2012), and adaptations were made to include specific acute stroke unit activities e.g. watching television, bed exercises, upper limb management (passive treatments such as positioning, application of functional electrical stimulation), and listening.

To determine the effect of visitor involvement on patient' activity levels we identified time periods when 'only visitors' were in attendance with the participant from the observation data. In addition, for each activity observed the behavioural mapping staff member recorded the level of assistance provided during the observed activity: independent, supervised, assistance or not applicable when no activity was observed. (Appendix 10)

6.3.4 Statistical analysis

Data was analysed on an intention to treat basis. Total activity in each activity domain was expressed as a proportion of the total number of recorded observations. To compare timing of patient activities we compared predefined time periods of interest for analysis as: 1) weekdays during scheduled communal activities; 2) weekdays during non-scheduled communal activity; 3) weekdays after 5pm; and 4) weekends. The proportion of observations spent in activities ('any',

physical, social, and cognitive) within the above time periods, in addition to body position, location and people present were determined. Time periods when 'only visitors' were in attendance with the participant were also identified from the observational data. A one-way analysis of covariance (ANCOVA) was used to determine differences in timing and nature of activities, visitor involvement and level of assistance provided during activities between the control and enriched group for all comparisons adjusted for age, NIHSS and premorbid mRS. Unobserved and missing data were excluded from statistical analysis consistent with previous research in this field (Janssen et al., 2014b) and as defined in our statistical approach in section 3.3.7. Analysis were performed using IBM SPSS Statistics for Macintosh version 24.0 (IBM Corp., Armonk, N.Y., USA) and significance was set at $p<0.05$.

6.4 Results

Between June 2014 and February 2015 sixty-two participants provided written consent and were enrolled in the study. Two participants were withdrawn (one participant was later found not to be a stroke and one participant was discharged from hospital within 48 hours). Baseline characteristics are presented in Table 6.1, noting no significant differences between groups for all variables ($p>0.063$). Detailed demographic information, as well as the flow of participants through the study has previously been reported in Chapter 4.4.1.

Table 6-1 Baseline characteristics of participants

n (%) or Mean (SD)	Control *n* = 30	Enriched *n* = 30
Age (years)	76.0 (12.8)	76.7 (12.1)
Gender Male	17 (56.7%)	22 (73.3%)
Female	13 (43.3%)	8 (26.7%)
NIHSS	8.5 (6.4)	7.8 (5.8)
Premorbid mRS		
0	20 (66.7%)	14 (46.7%)
1	6 (20%)	4 (13.3%)
2	4 (13.3%)	12 (40.0%)
Stroke severity		
Mild	17 (56.7%)	18 (60.0%)
Mod	9 (30.0%)	9 (30.0%)
Severe	4 (13.3%)	3 (10%)

mRS: modified Rankin Scale. NIHSS: National Institutes of Health Stroke Scale.

6.4.1 Effect of enrichment on timing of activity

Baseline characteristics were similar between control and enriched groups for each predefined time period of exploration ($p>0.05$). Table 6.2 shows that:

1) The proportion of time spent doing 'any', physical, social and cognitive activity was significantly greater in the enriched group during 'weekday scheduled communal activity' periods. As well, there was reduced proportion of time spent in supine position, in their room and alone when compared to the control group.

2) 'Weekday non-scheduled communal activity' periods showed that the enriched group spent a significantly greater proportion of time in 'any' and cognitive activity, but no difference was found for physical and social activity when compared to the control group. Furthermore, the enriched group spent a reduced proportion of time spent in supine position and in their room, but no difference was found in time spent alone when compared to the control group.

3) 'Weekdays after 5pm' showed no difference between groups for 'any', physical, social and cognitive activity, as well as for proportion of time spent in their room or being alone. 'Weekdays after 5pm' only showed a significant difference in favour for the enriched environment for reduced proportion of time spent in supine body position.

4) The proportion of time spent on 'any', physical, and cognitive activity was significantly greater on 'weekends' in the enriched group, but no difference in social activity levels were observed when compared to the control group. The enriched group also spent significantly reduced time in supine position and in their room on 'weekends', but no difference in time spent alone when compared to the control group. See Table 6.2.

Table 6-2 Mean participant activity levels, body position, location and people present expressed as % of total observations (SD) for Control and Enriched Environment group for defined time periods. One-Way ANCOVA between group differences (Enriched – Control) expressed in Mean (95%CI)[1] and P value

	Weekday scheduled activity Control n=28 Enriched n=29	Weekday non-scheduled activity Control n=28 Enriched n=29	Weekday >5pm Control n=28 Enriched n=29	Weekend day Control n=26 Enriched n=26	Only visitors Control n=30 Enriched n=29
Any Activity					
Control	65.7 (19.1)	60.0 (20.5)	54.3 (32.4)	48.4 (28.6)	87.3 (20.2)
Enriched	83.3 (15.5)	74.4 (18.7)	60.0 (25.5)	64.3 (20.8)	92.0 (16.1)
Enriched-Control[1]	16.0 (8.5-23.6)	12.7 (3.7 to 21.8)	6.1 (-6.2 to 18.4)	15.5 (2.8 to 28.2)	4.2 (-4.2 to 12.5)
P value	<0.001	0.007	0.324	0.018	0.324
Physical					
Control	24.8 (12.6)	25.6 (12.8)	27.1 (23.1)	17.0 (9.5)	13.7 (13.2)
Enriched	42.6 (15.8)	29.1 (12.7)	33.6 (21.9)	28.6 (17.0)	24.0 (17.0)
Enriched-Control[1]	16.6 (9.3 to 24.0)	3.9 (-2.7 to 10.5)	6.5 (-4.6 to 17.5)	11.1 (3.9 to 18.3)	9.0 (1.1 to 16.8)
P value	<0.001	0.240	0.246	0.003	0.026
Social					
Control	37.6 (18.4)	34.4 (15.1)	24.2 (22.7)	22.0 (14.8)	74.9 (26.5)
Enriched	66.9 (18.2)	39.9 (17.2)	26.3 (23.8)	30.4 (18.2)	81.2 (22.8)
Enriched-Control[1]	26.6 (17.9 to35.4)	3.6 (-4.0 to11.2)	3.2 (-8.8 to 15.3)	8.4 (-0.7 to 17.5)	7.1 (-3.9 to 18.1)
P value	<0.001	0.347	0.591	0.071	0.202
Cognitive					
Control	54.4 (18.0)	49.9 (16.9)	39.3 (30.4)	32.2 (27.6)	75.6 (26.3)
Enriched	75.7 (14.0)	63.8 (17.0)	42.8 (27.3)	53.6 (22.2)	90.1 (15.7)
Enriched-Control[1]	19.2 (11.2 to 27.2)	12.1 (3.6 to 20.6)	4.2 (-10.3 to 18.7)	20.6 (7.4 to 33.9)	13.6 (3.4 to 23.8)
P value	<0.001	0.006	0.564	0.003	0.010
Supine					
Control	66.1 (22.0)	57.8 (20.3)	82.8 (18.8)	72.6 (22.4)	72.3 (29.0)
Enriched	27.7 (21.3)	40.5 (26.7)	64.1 (31.4)	48.3 (27.0)	44.4 (30.9)
Enriched-Control[1]	-37.3 (-49.0 to -25.5)	-14.6 (-27.4 to -1.8)	-17.5 (-31.3 to -3.7)	-23.1 (-37.2 to -8.9)	-23.8 (-40.0 to -7.5)
P value	<0.001	0.026	0.014	0.002	0.005

In room					
Control	95.8 (7.4)	90.4 (5.3)	99.1 (25.7)	96.3 (2.9)	99.1 (2.9)
Enriched	51.4 (15.0)	79.8 (10.0)	93.9 (11.4)	85.3 (16.2)	89.0 (19.6)
Enriched-Control[1]	-43.0 (-49.2 to -36.9)	-9.8 (-14.3 to -5.3)	-4.3 (-8.9 to 0.2)	-11.3 (-18.0 to -4.5)	-9.2 (-16.5 to -1.8)
P value	<0.001	<0.001	0.063	0.002	0.016
Alone					
Control	49.6 (17.9)	54.1 (13.9)	69.0 (24.2)	62.5 (17.3)	-
Enriched	22.1 (11.4)	46.3 (15.3)	69.2 (22.8)	61.8 (16.3)	-
Enriched-Control[1]	-26.1 (-34.5 to -17.7)	-7.5 (-15.8 to 0.7)	-0.6 (-13.3 to 12.1)	-2.3 (-12.1 to 7.5)	-
P value	<0.001	0.073	0.929	0.632	-

6.4.2 Effect of enrichment on nature of activities

The majority of time was spent on cognitive, then social and physical activities in the acute stroke unit regardless of whether participants were in the enriched or control group. When physical activities were investigated, most time was spent on upper limb activity, and a trend towards increased time walking and doing other physical activities was observed e.g. seated exercise bike or wheelchair driving in the enriched group compared to the control group. Social activities showed that group socialisation was significantly greater in the enriched group when compared to the control group. Cognitive activities as listening and proportion of time spent on the computer/iPad were greater in the enriched group when compared to the control group, but no difference between groups was found for watching television. (Table 6.3)

Table 6.3 shows that enriched participants spent less time lying, but significantly more time sitting up and standing when compared to the control group. Furthermore, the enriched participants spent more time out of their room, and in therapy and communal areas, less time alone and more time with other patients, therapists and AHAs than control participants. No difference between groups was observed for proportion of time spent with nursing staff. (Table 6.3)

Table 6-3 Proportion of nature of activities observed in control versus enriched group expressed in mean % (SD) and mean (95%CI) for between group differences.

	Control group n=30	Enriched group n=30	Between group differences (Enriched-Control)*	P value*
Physical activities				
Walking	1.0 (1.1)	2.8 (3.9)	1.4 (0.1 to 2.9)	0.066
Upper limb	3.6 (3.5)	8.4 (6.9)	5.4 (2.7 to 8.1)	0.000
Toileting	1.6 (1.3)	2.5 (2.2)	0.8 (-0.1 to 1.7	0.088
Eating	7.4 (3.8)	7.0 (2.6)	-0.8 (-2.4 to 0.9)	0.353
Drinking	1.9 (1.9)	2.4 (1.8)	0.5 (-0.5 to 1.4)	0.346
Other	0.4 (0.6)	2.7 (6.9)	2.4 (0.1 to 5.0)	0.056
Social activities				
Talking	26.1 (13.7)	30.0 (13.5)	3.7 (-3.0 to 10.3)	0.271
Telephone	2.4 (5.3)	1.3 (2.2)	-1.6 (-3.7 to 0.5)	0.127
Group socialisation	0	6.2 (3.6)	6.1 (4.7 to 7.4)	0.000
Cognitive activities				
Reading	6.5 (13.5)	6.9 (7.4)	1.2 (-4.4 to 6.8)	0.666
Listening	29.3 (13.9)	39.5 (12.7)	9.8 (2.8 to 16.7)	0.007
TV	6.3 (11.4)	6.7 (8.6)	-0.4 (-6.0 to 5.2)	0.893
Computer/ iPad	0.2 (0.7)	2.7 (4.5)	2.8 (1.1 to 4.4)	0.002
Other	1.0 (2.5)	2.8 (6.9)	1.8 (-0.9 to 4.4)	0.189
Position				
Supine	68.0 (16.7)	45.0 (22.0)	-21.3 (-31.7 to -11.0)	0.000
Sitting tilt chair	6.5 (9.5)	4.3 (9.9)	-1.5 (-5.3 to 2.2)	0.417
Sitting chair	17.8 (16.5)	38.9 (23.0)	18.6 (8.7 to 28.5)	0.000
Sit unsupported	5.1 (5.9)	4.3 (7.1)	-0.5 (-3.9 to 3.0)	0.791
Standing	2.6 (3.1)	5.8 (6.0)	3.0 (0.5 to 5.4)	0.018
Location				
Bed room	94.5 (2.7)	79.0 (9.1)	-15.2 (-18.8 to -11.5)	0.000
Ensuite	3.9 (1.9)	5.2 (2.4)	1.3 (0.2 to 2.4)	0.020
Therapy/dining room	0.9 (1.4)	7.9 (4.0)	7.2 (5.5 to 8.9)	0.000
Communal area	0.7 (0.8)	5.1 (4.7)	3.9 (2.2 to 5.7)	0.000
People present				
Nursing	14.1 (5.8)	13.5 (5.7)	-0.8 (-3.4 to 1.9)	0.566
Patients	0.7 (2.2)	4.8 (3.7)	4.2 (2.6 to 5.8)	0.000
Therapist	6.9 (3.8)	9.6 (5.5)	2.8 (0.2 to 5.3)	0.036
AH assistant	1.9 (1.7)	6.6 (3.3)	4.7 (3.3 to 6.2)	0.000
Visitors	20.6 (13.1)	24.1 (13.8)	3.9 (-3.4 to 11.3)	0.289
Alone	58.9 (13.9)	51.0 (13.8)	-8.3 (-16.0 to -0.6)	0.035

NIHSS: National Institutes of Health Stroke Scale. mRS: modified Rankin Scale. SD: Standard Deviation. CI: confidence interval.
Activities performed <2% for both groups not reported on significant + not significant
*One-way ANCOVA adjusted for covariates age, NIHSS and premorbid mRS.

6.4.3 Effect of enrichment on visitor involvement

All participants spent time with 'only visitors' in attendance except for one. A similar proportion of time was spent with 'only visitors present' in each group (enriched: 17.4% (SD11.1), control: 16.8% (SD10.5), p=0.560). When 'only visitors' were in attendance, the enriched group spent a significant greater proportion of time on physical and cognitive activity, in addition to reduced time spent in supine body position and in their room compared to the control group (Table 6.2).

6.4.4 Effect of enrichment on amount of staff assistance

When assistance provided by staff was examined, there was no difference in the amount of assistance provided by staff between groups (enriched: 6.6% ±5.1% time spent with assistance vs. control group 4.5% ±3.5%, p=0.055). The total proportion of activities undertaken independent, supervised or assisted by staff for each activity domain are presented in figure 6.1.

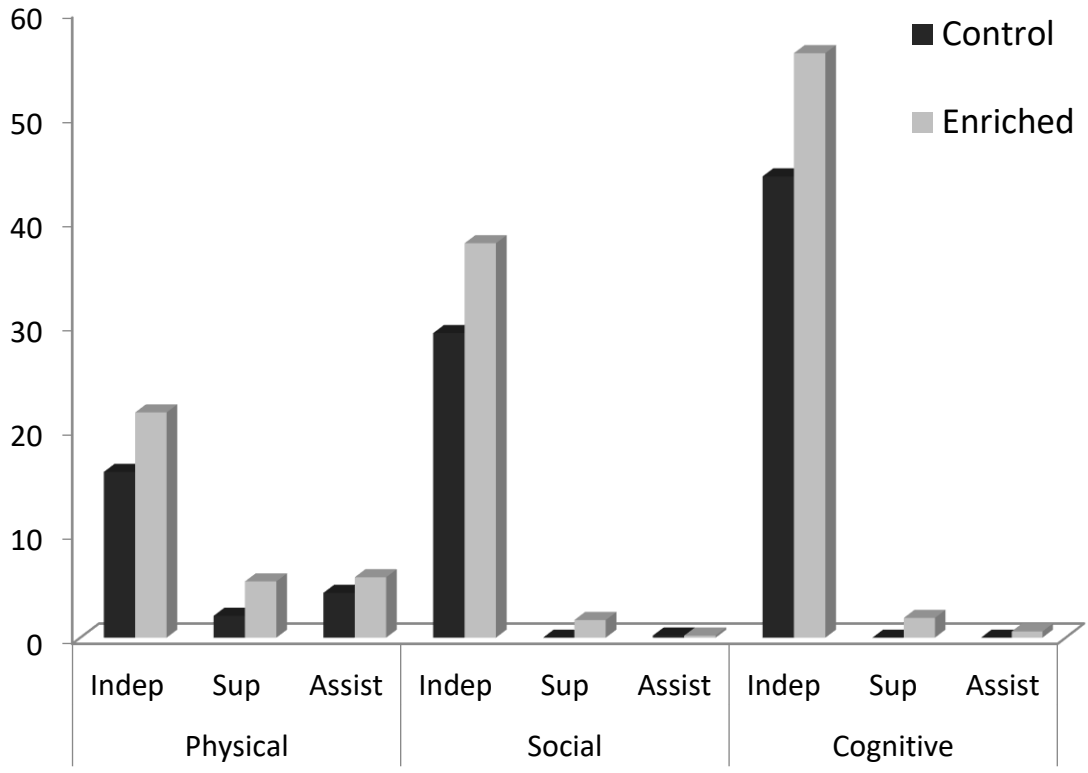

Figure 6-1 Proportion of activities performed independent, supervised or assisted in the control and enriched group.

6.5 Discussion

We have demonstrated that embedding an enriched environment in an acute stroke unit increased engagement of stroke patients in a wide variety of activities across the majority of the day as compared to the control group. Stroke patients demonstrated greatest increase in activity during scheduled communal activity, on weekends, and during visitor involvement within an enriched environment, which led to an increase in upper limb activity, group socialisation and engagement with technologies such as iPads. Furthermore, no difference in amount of staff assistance was observed in the enriched environment to facilitate increased patient activities.

Timing of activities demonstrated that the largest increase in activities occurred during scheduled communal activities on weekdays. Scheduled communal activities such as communal meals have previously been shown to give stroke patients frequent opportunities to ambulate and perform upper limb activity in acute stroke and rehabilitation units. (Askim et al., 2012; English et al., 2014; Hokstad et al., 2015). These scheduled communal activities likely contributed to the increased time participants spent on upper limb activity and a trend towards increased walking activity, as well as increased time sitting up and standing within the enriched environment. This suggests a potential positive therapeutic effect. Increased upper limb, standing and walking activity early after stroke may enable greater motor recovery (Thomas et al., 2017; Veerbeek et al., 2014). The recently published Australian Clinical Guidelines for Stroke Management (Stroke Foundation, 2017a) recommend two hours of daily active task practice in the rehabilitation phase after stroke, it would appear that enriching the inpatient environment is an important contributor to positively increase the amount of active task practice early after stroke. Taken together, this increases the rationale to further explore and refine the enriched environment and rehabilitation model

The control group showed high levels of inactivity during weekend periods, consistent with previous research (Janssen et al., 2014a; King et al., 2011). We found that on weekends the enriched environment model increased physical and cognitive activity, and reduced time spent in bed. As this is a time when no therapists and reduced nursing staff were available to support the enriched environment concept, it is encouraging to see that enrichment was able to make an impact. A variety of mechanisms may have supported this increase in activity including 1) independent practice as a result of providing stimulating resources and self-practice interventions at the patient bedside; 2) visitor involvement; 3) a change in approach of nursing staff on weekends; 4) education of participants regarding benefits of increased activity after stroke; and 5) environmental factors such as communal spaces, and empowering participants to access outdoor spaces with families. However, even with increased activity levels observed in the enriched group, participants still spent

the majority of the day in their room (85.3%) and alone (61.8%) on weekends. This suggests further refinement of the enriched environment model is needed to enhance activity on weekends in an acute stroke unit that encourages patients to go outside their room.

Within the enriched environment participants showed limited engagement in social activities outside the weekday scheduled communal activity periods. Animal models have shown that an enriched environment was most effective when all components of environmental enrichment were included: physical activity, socialisation and cognitive stimulation (Gentile et al., 1987; Risedal et al., 2002). We transformed public space in the acute stroke unit into small communal seating areas e.g. front of the elevators, to encourage social interaction and time away from the bedside. Physical build design of the ward can impact on patient activity (Blennerhassett et al., 2018; Shannon et al., 2018). For example, a study that tracked stroke patients in a stroke unit pre and post reconstruction of the environment highlighted how location of the communal space and bed lay out (single vs. multi- bedrooms) influenced activity levels of stroke patients (Anaker et al., 2017). Thus, an enriched environment model may be enhanced when the physical design of the unit supports social activity and rehabilitation, and time spent away from the bedside.

The enriched group performed activities on the iPad more frequently than the control group. This is not surprising in some ways as we offered all enrichment participants a tablet. However, provision of technology alone does not necessarily mean a person will use it. There is growing evidence to demonstrate that tablet technology is well accepted in stroke patients (White et al., 2015a), and effective at increasing communication activities in targeted rehabilitation interventions (Mallet et al., 2016). This suggests that incorporating tablets and therapy apps that are meaningful and interesting for stroke patients may be an effective strategy to stimulate cognitive activity within the acute stroke unit environment.

Despite unchanged staffing levels, participants spent increased time with therapists, AHAs and other patients within an enriched environment. This highlights that the enriched environment enabled allied health professionals to spend more time with participants, rather than less. This positive effect of the embedded enrichment model is important, as time in therapy early after stroke is limited (Bernhardt et al., 2007; King et al., 2011). The enriched environment model achieved increased patient activity levels without a significant increase in direct staff assistance for participants. Communal activities enabled staff to supervise several patients at the same time, and created complex social and cognitive stimulating situations. However, it highlights that it is important to determine whether allied health professionals perceived an increase in workload while working within the enriched environment. Staff interviews and surveys explored staff perception and perceived workload, and will be discussed in Chapter 7. While nursing staff overall spent more

time with participants than therapists, there was no difference in time spent with nursing staff between groups. Clearer conceptualisation of the responsibility to increase activity in stroke patients may enhance the perception by patients that nursing staff are key interdisciplinary rehabilitation staff members (Loft et al., 2017). This suggests that exploring nursing staff experience within the enriched environment, as well as innovative ways of enabling nursing staff to incorporate patient activity could further strengthen the enrichment model. Visitor involvement contributed to higher patient activity in the enriched environment suggesting that information of benefits of activity after stroke, brochures, encouraging families to take participants outside their bedroom, and activity cards at the bedside were successful strategies to facilitate family involvement.

Clinical translation of environmental enrichment is in its infancy. During the design phase of our enrichment model we deliberately chose enrichment strategies that adhered to the underlying conceptual principles of the enriched environment. In our opinion it is essential that clinical enrichment models stay aligned with these underlying theoretical principles as environmental enrichment is neither therapy nor a simple change to the environment. Unpacking the observational data has revealed valuable insights about when and what type of activities participants engaged in during the day, and which enrichment strategies may have contributed to increased activity, which can inform future studies. A strength of our study is the large number of observations (control 4,606, enriched 4,522), with minimal missing data (control 0.6%, enriched 0.2%), which provided a comprehensive view of patient activity. However, there are several limitations to this study. First, the study was conducted in one acute stroke unit and factors such as team commitment and organisational aspects, which may have contributed to the impact on increasing activity, were not explored. Second, we observed patients on particular days and content of group activities on those days may have impacted the activity taken. To reduce this impact we organised behavioural mapping on a variety of weekdays and a weekend day, which reduced participants being observed on same days. Lastly, we were unable to comment if the enrichment model increased activities that were targeted to each individual's impairments, activities and participation limitations.

6.6 Conclusion

An enriched environment in an acute stroke unit can increase activity levels in stroke survivors. Stroke survivors demonstrated increased activity during periods of scheduled communal activity, on weekends, and during visitor involvement within an enriched environment, which led to an increase in upper limb activity, group socialisation and engagement with technologies such as iPads.

Furthermore, no difference in amount of staff assistance was observed in the enriched environment to facilitate increased patient activities. This information is important to inform future trials and translation of environmental enrichment in stroke clinical settings.

Chapter 7 is in part adapted from the following publication
(Appendix 4 URL Link to Published Paper)

A qualitative investigation of the perceptions and experiences of nursing and allied health professionals involved in the implementation of an enriched environment in an Australian acute stroke unit.

Rosbergen ICM, Brauer SG, Fitzhenry S, Grimley RS, Hayward KS.

BMJ open 2017;7(12):e018226

and was presented at

Scientific Meeting of the Stroke Society of Australasia, August 2017. Queenstown, New Zealand

(Platform presentation)

Chapter 7 Study 4 Staff, patient and carer experience

7.1 Abstract

Background: The objective of this study was to understand perceptions and experiences of clinical staff, patients and carers involved in implementing an enriched environment in an acute stroke unit.

Methods: This mixed model design included semi-structured interviews with nursing and allied health staff, and surveys with clinical staff, patients and carers. *Semi-structured interviews:* Three allied health and seven nursing professionals involved in the delivery of the enriched environment were purposively recruited. Face-to-face, semi-structured interviews were conducted eight weeks post-completion of the enriched environment study, but before the sustainability period. One independent researcher completed all interviews, and three researchers analysed the interviews using a thematic approach to identify main themes. *Surveys:* Clinical staff surveys were conducted within the control (usual care) and intervention (enriched environment) period to capture a broader sample of staff, while patients and carers completed a satisfaction survey when discharged from the acute stroke unit in either the control or enriched period.

Results: Three themes were identified from the interviews. First, staff perceived that *'the road to recovery had started*' for patients. An enriched environment was described to shift the focus to recovery in the acute setting, which was experienced through increased patient activity, greater psychological wellbeing, and empowering patients and families. Second, *'it takes a team'* to successfully create an enriched environment. Integral to building the team were positive interdisciplinary team dynamics and education. Third, *'keeping it going'* was perceived to be challenging. Contextual factors such as a supportive physical environment and variety in individual enrichment opportunities were indicated to enhance implementation. Key factors to sustaining change were consistency in staff and use of change management strategies. Clinical staff surveys supported the view that clinical staff perceived the enriched environment to increase stimulation to patients to be active. Satisfaction explored in patients and carers surveys suggested that patients felt more part of the team within the enriched environment, and that patients and carers appeared to accept the enriched environment.

Conclusion: Investigating staff perceptions and experiences of an enrichment model in an acute stroke unit highlighted the need for effective teamwork and change management strategies to support clinical translation of an enriched environment.

7.2 Background

The first clinical study in a human stroke population translated an enriched environment into a sub-acute inpatient rehabilitation setting (Janssen et al., 2014b). In this study environmental enrichment included provision of stimulating resources in the rehabilitation ward and at the patient bedside to encourage activity (Janssen et al., 2012). Our group translated an enriched environment into an acute stroke unit (Chapter 4 and 5). We adapted the enriched environment intervention based on findings in the sub-acute rehabilitation setting to tailor the intervention to the unique context of an acute stroke unit. Similar to animal models, both these clinical studies showed that environmental enrichment increased engagement in physical, social and cognitive activities in the subacute inpatient rehabilitation (Janssen et al., 2014b), and acute stroke unit setting (Rosbergen et al., 2017).

The acute stroke unit presents a multitude of new challenges that may impede direct clinical translation of the enriched environment model that was successful in the subacute inpatient rehabilitation setting (Janssen et al., 2014b). In the acute stroke unit, patients are often dependent on staff assistance (Nursiswati et al., 2017), and require frequent medical investigations and interventions during the day (Clarke & Forster, 2015). In the sub-acute rehabilitation setting, where patient dependency is lower than in the acute stroke unit (Nursiswati et al., 2017), staff reported that providing assistance to patients was a key limiting factor in patients accessing communal enrichment areas (White et al., 2014). To address this issue, we included scheduled communal activities with clear responsibilities for nursing and allied health professionals to enable 'mobility assistance' in our enrichment model. Staff in the enriched subacute inpatient setting acknowledged that the enriched environment made a positive impact on patient engagement in activities, and patients appeared less bored. However, staff perceived that the enriched environment intervention increased their workload, while 'nurses were already so busy' (White et al., 2014), which may negatively impact on sustainability of an intervention. In the acute stroke unit we incorporated scheduled communal activities, which showed to successfully increase patient activity, but how did these activities impact on staff perceptions and workload? Furthermore, patients, carers and families are often in a heightened emotional state early after stroke (Lutz et al., 2011), and there is a high turnover of patients in the acute setting (Australian Institute of Health and Welfare, 2013). These characteristics can quickly lead to an extra burden of workload when work routine is changed. Therefore, it is critical to investigate how the enriched environment model in the acute stroke unit impacted on staff perspectives and experiences while working in the enriched unit.

Evaluating patient experiences is another key component of process evaluation of a new intervention (Moore et al., 2015). Consumer experience of physical rehabilitation investigated in a systematic review spanning the acute and subacute inpatient setting including 31 studies, revealed that stroke survivors highly value physical activity and believe that more physical activity is better for recovery (Luker et al., 2015). Stroke survivors expressed they felt bored and alone during their inpatient stay, and they wanted to practice meaningful activities and more opportunities to engage in recreational activities (Luker et al., 2015). A review investigating boredom in people with acquired brain injuries (ABI) (n=24 studies, n=20 stroke, n=2 ABI, and n=2 mixed cohorts), showed that boredom was a very common experience while staying in inpatient rehabilitation settings and negatively impacted on their mood and feelings of control. Patients highlighted that communal areas and outdoor spaces, which provided opportunities for engagement in activities, reduced boredom (Kenah et al., 2017). (See details in section 2.1.8) Interviews with stroke survivors who recovered within the enriched subacute rehabilitation setting showed that stroke survivors highly valued social interaction, so they could share experiences with other patients and families within enriched communal areas (White et al., 2015b). Furthermore, environmental enrichment reduced their feelings of boredom and increased their feelings of control, as the environment stimulated physical, social cognitive activity. Stroke survivors who were restricted in their mobility reported feelings of frustration in their inability to access communal areas, and frequently felt they were a burden to staff in asking for assistance (White et al., 2015b). Taken together, stroke survivors' experiences of boredom and lack of opportunities to be active within inpatient rehabilitation settings, as well as stroke survivors' feeling frustrated in their inability to access communal areas within the enriched subacute inpatient setting, highlights the need to investigate how patients perceived and experienced the enriched environment in the acute stroke unit.

Beside stroke patients themselves, carers have an important role in stroke recovery and rehabilitation. Carers frequently enable stroke survivors to remain living in the community (Stroke Foundation, 2007), so they are important stakeholders in the stroke survivors' recovery process. Furthermore, Stroke Foundation Clinical Guidelines for Stroke Management (2017) recommend to actively engage carers in the stroke survivors' recovery process. The enriched environment model embedded in the acute stroke unit encouraged carer involvement: information was provided to patients and carers about the benefits of early activity after stroke (Appendix 9), to facilitate patient activity outside therapy hours, and to bring in personal items for the patients such as hobby activities and clothing. Carers have previously reported feeling frustrated when staff did not allow them to be actively involved in stroke survivors' rehabilitation (Luker et al., 2017). Indeed, carers have indicated that their involvement could enhance meaningful rehabilitation and aid patient

recovery (Luker et al., 2017). Therefore, investigating how carers experienced and perceived their involvement in the enriched environment in the acute stroke unit is important for future research in this field.

Translating a complex intervention such as an enriched environment into clinical practice is challenging (Johnson & May, 2015). Evidence suggests that comprehensive approaches are required to change behaviour at a variety of levels including the patient, multidisciplinary team, and broader hospital level (Grol & Grimshaw, 2003). Exploring barriers and facilitators of a new intervention with staff and consumers are considered important to facilitate understanding of the impact of the intervention at the different levels of the individual, team and organisation (Grol & Grimshaw, 2003). Tailored implementation strategies can be selected to support all individuals involved in changing clinical practice after rigorous exploration has been undertaken of the context (Grol & Grimshaw, 2003). To understand relationships between implementation, the unique context of the acute stroke unit, and how the delivered intervention created change (Moore et al., 2015), investigating staff, patient and carers perceptions and experiences is one key component of process evaluation (Moore et al., 2015).

Therefore, the first aim of this Chapter was to understand the perceptions and experiences of nursing and allied health professionals who implemented the enriched environment within the acute stroke unit using semi-structured interviews. Staff reflections will contribute to the refinement of an enrichment model for the acute stroke unit to inform future clinical translation. (Section 7.3 and 7.4) The second aim of this Chapter was to explore the perspectives and experiences from staff, patients and carers within the usual care (control) and enriched environment (intervention) period. To address this aim surveys were used to allow comparing staff, patient and carers perspectives across both study periods. (Section 7.5 and 7.6)

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7.3 Semi-structured interviews staff

7.3.1 Methods

The study reported here is a sub-component of a before-after pilot study. We conducted qualitative interviews 8-weeks post the enriched environment period. Ethical approval was obtained from The Prince Charles Hospital and the University of Queensland ethics committees (HREC/14/QPCH/21 and MREC/2014000371). This study was conducted in accordance with the Declaration of Helsinki.

7.3.2 Author's relationships with participants

The principal investigator (IR) had a professional relationship with all participants as she was a senior physiotherapist in the unit and the primary study (Chapter 4) formed part of her PhD. An independent researcher conducted all interviews to allow staff to reflect their honest perceptions and experiences of the enriched environment intervention. The interviewer (SF) was a specialised neurology physiotherapist working in ambulatory rehabilitation. She received training in interview techniques and had recent experience undertaking in-depth interviews. SF had no relationship with the initial pilot study 'enriched environment in the acute stroke unit' (Rosbergen et al., 2016), and no prior engagement with participants. IR and KH (independent of the trial site) developed the interview guide for the interviewer. To overcome personal bias of IR to study and participants, three researchers (SF, KH, IR) analysed all collected data independently. All authors contributed to the manuscript using reporting checklists for qualitative studies (Tong et al., 2007).

7.3.3 Design and participants

We used a descriptive qualitative design. Semi-structured interviews with open questions and prompts were undertaken to collect individual staff perceptions and experiences (Grossoehme, 2014; Patton, 2015). The semi-structured interviews were conducted with nursing and allied health professionals working on the acute stroke unit in a regional Australian hospital. Staff members were eligible to partake in a semi-structured interview if they had worked in the acute stroke unit during the enriched environment period of the pilot study. We wanted to understand the experiences of a diversity of staff members to capture the complexity of embedding a new multidisciplinary intervention. We selected a purposive sample (Palinkas et al., 2015), and recruited participants with a variety in sex, age, educational level, nursing roles, allied health disciplines and work experience on the acute stroke unit. Participant recruitment was ceased upon saturation of the data, which was deemed to be the point where no additional information was added to identify new meaningful concepts. To enhance rigor we focused on elements of trustworthiness using the framework of credibility, transferability, confirmability and dependability (Shenton, 2004).

7.3.4 Data collection

Semi-structured interviews were performed in a quiet room within the hospital using an interview guide (see Table 7.1). No other people were present during interviews. The facilitator (SF) encouraged participants to share their personal experiences and meanings they attributed to working within the enriched acute stroke unit, and used probing techniques and prompts to achieve further in-depth reflection. Participants were asked to reflect on the recently completed enriched environment intervention and how this intervention impacted stroke patients, their families and staff members (themselves and others). At the end of the interview the facilitator rephrased main experiences and meanings expressed by the participant to ensure provided information reflected the participant's views accurately. Interviews were audio recorded and no field notes were made during interviews.

Table 7-1 Interview guide

Interview guide: Main questions and prompts to guide interview of all participants.
What was your understanding of the enriched environment intervention? • What changes did you notice during the enriched environment on the ward? • Can you report on the changes that you noticed for patients, families, nursing staff, allied health staff and other staff? • What were your expectations regarding the enriched environment?
Discuss the content of the enriched environment intervention. • How did you implement the different aspects of the intervention? • How did you feel about the different aspects of the intervention? • What guidance is needed to implement the intervention?
Were there any problems as well as rewarding situations during the enriched environment intervention? • Was there anything that stopped you from implementing the enriched environment? • Did you experience any problems with increasing patient activity (physical, social and cognitive)? • Have you found a way to cope with any barriers in enriching the environment?
Has the enriched environment changed any team dynamics? • Did the enriched environment change the communication within the team? • How do you feel about these changes? • Did the intervention change your communication with patients and families?
What advice do you have on how we can sustain the enriched environment in the future? • What do you need to be able to sustain the enriched environment? • What aspects do you think are hard to sustain? • Do you have ideas how to solve this?

7.3.5 Enriched environment intervention

Usual care in the stroke unit has been described in Chapter 3 and Chapter 4 (Rosbergen et al., 2017; Rosbergen et al., 2016). The enriched environment intervention embedded in the acute stroke unit focused on three key areas summarised briefly below.

1) Embedding a stimulating environment in the acute stroke unit through creation of public communal spaces and provision of stimulating resources e.g. newspapers, iPads, books and games throughout the ward and at the patient bedside. We commenced daily communal breakfast and lunch times, as well as daily group activities to provide opportunities for patients to increase their activity levels.

2) Encouraging patient and family involvement through provision of an information brochure and face to face education that explained why activity after stroke was important, how patients and families could contribute to increasing activity levels, and explained the day structure of the ward. We also provided individualised activity cards at the patient's bedside with suggestions for patients and families to increase activity that related to the patient's goals.

3) Educating staff to enhance patient activity through interactive educational workshops that were provided to nursing and allied health professionals in small groups prior to the commencement of the enriched environment. We explained the theoretical background of an enriched environment, and discussed key intervention strategies. Staff members were encouraged during these sessions to explore and discuss possible barriers and enablers of enrichment strategies. In addition, investigators explained the role of appointed nurse champions to facilitate enrichment on a day-to-day basis and transparent staff responsibilities were described in an intervention protocol. (Appendix 7)

During the implementation phase of the intervention direct feedback to staff members was provided and we distributed newsletters every three weeks to repeat key intervention strategies. These newsletters also included patients and carers feedback.

7.3.6 Data analysis

Interviews were transcribed verbatim by a professional transcription agency (Pacific Transcription, Australia). We used a thematic content approach to capture important information related to our research aim (Braun & Clarke, 2006). The transcriptions were first reviewed by the interviewer (SF)

to ensure the content accurately reflected each interview to enhance dependability. After initial review three researchers performed data analysis to avoid any potential bias or personal motivations promoting confirmability. First, researchers (IR, KH, SF) independently read and became familiarised with the complete data set. Second, investigators went through the transcripts line by line to obtain meaningful information and identified repeated topics and patterns. Researchers then interactively discussed interpretation of data to avoid bias in analysis, and collapsed data into categories. Credibility was enhanced through repeated discussions during the analysis process clarifying accurate interpretation of the data. Fourth, researchers re-read all transcripts to confirm that all data fitted into the identified categories and potential relations to key themes were identified. Researchers met a further three times to discuss and reframe key themes and subthemes ensuring consistency of findings between researchers, and that defined themes accurately reflected the expressions of the participants. Lastly, quotations and sections of text were extracted under thematic content and checked for consistency with the narrative theme. During the writing stage further refinement of links and subthemes occurred to ensure consistency of themes. All changes were discussed at each step between the three researchers to achieve consensus. Final transcripts and results of the analysis were not discussed with participants.

7.4 Results

IR approached seven nursing staff, two senior therapists and one AHA face to face to participate in the study. No participants approached declined to participate, and all invited individuals provided written informed consent. (Appendix 12) Two participants commenced working in the acute stroke unit after the interactive educational workshops were held. The characteristics of participants can be found in Table 7.2. To protect the identity of our participants we have not specified sex, roles, disciplines or educational background in detail. The study sample included two male participants. Interviews were conducted five to eight weeks post completion of the enriched environment intervention period and prior to analyses of the primary before-after study. The mean interview duration was 34.4 minutes.

Table 7-2 Characteristics of participants

n	Discipline	Age (years)	Work experience in ASU	Participated in education session	Duration of interview (minutes)	Nurse Champion
1	Nursing	> 40	2-5 years	Yes	40	Yes
2	AH	> 40	2-5 years	Yes	38	-
3	AH	> 40	> 5 years	Yes	48	-
4	Nursing	< 40	< 2 years	Yes	20	Yes
5	Nursing	> 40	> 5 years	Yes	36	Yes
6	Nursing	> 40	> 5 years	Yes	32	No
7	Nursing	> 40	< 2 years	No	16	No
8	AH	> 40	< 2 years	No	60	-
9	Nursing	> 40	> 5 years	Yes	28	Yes
10	Nursing	< 40	< 2 years	Yes	26	Yes

Abbreviations: ASU: Acute Stroke Unit. AH: Allied Health.

7.4.1 Overview of themes:

Three main themes, each containing subthemes, were identified. A summary of the themes and sub-themes are presented in Table 7.3.

Table 7-3 Summary of themes

Main theme	Sub-themes
'The road to recovery has started' for patients	Focus shifted to 'acute care and recovery' Improved psychological wellbeing Observed increased activity levels Empowering patients and families
'It takes a team' to successfully create an enriched environment	Impact on workload Team dynamics Importance of team education
'Keeping it going' requires building routine	Changing work routines challenging Impacting contextual factors Sustaining work practices

7.4.1.1 Theme 1: ‘The road to recovery has started’

Nursing and allied health staff expressed that the enriched environment created more opportunities for patients to be physically, socially and cognitively active during the day as compared with usual care. Staff perceived that the enriched environment positively contributed to patients’ recovery. The following sub-themes were constructed.

Focus shifted to ‘acute care and recovery’

Staff perceived that the acute stroke unit shifted from ‘acute care’ to ‘acute care and recovery’ for patients. Patients were sitting out of bed more frequently in a ‘homely environment’, and the daily structure was more like ‘a normal day at home’. In addition, families were increasingly inclined to take patients outdoors or to communal areas for coffee or for social interactions in a less institutionalised environment.

> *We have bridged the gap between the acute and rehabilitation setting, and we have started the rehabilitation process from day one. (Allied Health 8)*

Improved psychological wellbeing

Staff reflected that the enriched environment improved psychological wellbeing of stroke patients and their families. Patients appeared to be more active, alert, positive and less bored. These positive observations reinforced staff to continue implementation of enrichment strategies. In addition, staff experienced that families and patients provided positive feedback about the enriched environment and expressed optimism in future outcomes after stroke.

> *Patients have voiced that they’ve enjoyed interacting with other patients and that families reported to have enjoyed the interaction with other patients. They found it not so lonely being in hospital, because they have people to talk to. (Nurse 4)*

> *I am finding patients are a lot happier. I think because their day is not just taken up with lying around in bed. There is more to do. (Nurse 5)*

Observed increased activity levels

Staff perceived that greater levels of patient activity were observed in the enriched acute stroke unit than prior to enrichment. Communal mealtimes were considered to enhance frequent physical activity e.g. walking to and from meals and sitting up for breakfast and lunch. Furthermore, mealtimes and group activities enabled social interaction as patients shared their personal stories. Staff stated that they received positive comments from patients and families regarding communal mealtimes.

> *A major difference is the meal times, getting the patients out to socialise with other patients. They spend more time out of their bed. (Nurse 4)*

Staff expressed that increased patient activity contributed to patients' recovery in a positive way. Structured activities such as mealtimes and group activities were perceived to be more successful in activating patients than non-structured activities such as stimulating resources at the bedside or in a communal area.

> *Upper limb groups tended to be in the afternoon. We have taken them away from their bed, into the rehab room. That actually really helped the afternoon process. (Allied Health 8)*

> *The not really structured moments where we encourage that people are getting outside their room…it still could be better. (Allied Health 3)*

However, it was noticed that some individuals preferred to stay in their own room. Staff found it challenging to enrich the environment for these patients and suggested that a larger variety of individually tailored activities at the bedside were needed to keep these patients active. Activities such as reading newspapers, doing games or therapy activities on the iPads gave patients cognitive stimulation during the day. While non-structured enrichment strategies relied on initiative of individual staff members, staff still valued these activities, as they created positive stimulating situations.

A couple of nurses started on the big table with a jigsaw - and a couple of patients were coming up, and they were all putting pieces together. That was good, it was much more communal, normal. (Nurse 1)

Empowering patients and families

The enriched environment was perceived to empower patients and families to have greater autonomy in their recovery journey. Staff reported that patients could indicate their preferred activities for the day and if they desired to attend any group activities. Staff also commented that families had provided feedback that an enriched environment delivered individualised care, as patients preferred activities were taken into account. In addition, staff perceived that family involvement in patient activities resulted in families feeling useful in the patient's recovery.

I will always ask for their hobbies…to get them active in the things they like. (Allied Health 3)

Trying to give over the therapeutic role to the family so that they can carry on. (Allied Health 8)

In contrast, staff experienced that family members occasionally looked awkward when a patient was attending a communal mealtime and that many required encouragement to join group activities. Staff suggested during interviews that family and patient education was required to explain the enriched environment concept to change their outlook regarding the acute hospital environment.

7.4.1.2 Theme 2: 'It takes a team'

Staff perceived that successful implementation of an enriched environment required involvement of all team members. Interdisciplinary teamwork became more visible within the enriched environment as staff worked cohesively to provide a stimulating environment for patients. Mealtimes or scheduled group activities required frequent communication between disciplines so patient care was kept running smoothly. Staff acknowledged that the enriched environment could be

challenging at times of competing priorities. However, staff overall perceived that the enriched environment was well accepted and resulted in higher personal work satisfaction.

> *I think there was more of a connection between nursing staff and therapy staff in terms of connecting around goals and activities that were provided to the patient. (Allied Health 8)*

> *It made us feel better because the patients seemed happier. I felt like I was doing my job as a nurse better because we were pushed more to do things that we should be doing anyway. (Nurse 10)*

Impact on workload

Conflicting messages were reported regarding the impact of an enriched environment on staff workload within the team. A few nursing staff members indicated that the enriched environment contributed to a reduction in nursing staff workload, as they experienced support from allied health professionals.

> *It kind of assisted us at the time with our workload, in a way, with the Physio's, OT's, taking patients down for lunches and breakfast. If they weren't in their room for us to feed them during lunch, it obviously freed us up. (Nurse 7)*

However, other nursing staff members experienced that implementing enrichment strategies was very challenging when high acuity patients were on the ward and during very busy shifts e.g., high patient turnover. Nursing staff reported that higher priorities at these times limited their capacity to embed enrichment strategies. No references within the data were found how allied health staff experienced impact on workload.

> *I think it is just dependent on the shift and the business of that shift. Just the acuity of the ward. If you got very unwell patients you are going to be focused on them and not getting someone out of bed for breakfast. (Nurse 4)*

It was when the ward got incredible heavy; we had 16 stroke patients in the acute stroke unit and 16 throughout the hospital. The most sick and heavy stroke patients were in the acute stroke unit. It was really just trying to get through the workload of the day. Probably the enriched environment took a back foot because of clinical intensity. (Nurse 1)

Team dynamics

Staff perceived commencement of new graduate nurses and casual staff as challenging as it changed knowledge within the team. Team champions attempted to provide information regarding the enriched environment concept and key strategies to new staff. However, nursing staff noticed that it was difficult for new staff to incorporate enrichment strategies in their routine.

I think a lot of us who are permanent staff on the ward were mostly all into it, but it's harder when you get other staff come on, which are casual or haven't worked here before. (Nurse 9)

I think what impacted us the most especially at the beginning of the year are new grads. So we got four new grads, four new nurses on contracts and lots of casual staff. So it really changes the dynamics of knowledge of the people who are here. So they are struggling just to get through the clinical load safely. (Nurse 1)

Some staff members did not change work practice and continued their old work routines. Staff reflected that intrinsic motivation is different for each staff member and played a role in the amount of staff involvement.

Some staff really took to the project and were up and going, and others not. It is very person centered and it depends on how enthusiastic the person is with their role. (Nurse 6)

Staff expressed that positive team dynamics supported embedding an enriched environment in the acute stroke unit. On weekdays, higher numbers of nursing and allied health professionals were present creating a dynamic interdisciplinary team who were collectively enriching the stroke unit.

On weekends, there was a lower nursing staff to patient ratio and no allied health professionals were available. This led to nursing staff perceiving that the enriched environment was a burden as it was 'on top of' usual practice.

> *I think there wasn't much support on weekends for nursing staff. It was basically up to us to do it. In all honesty, it's just something else added to our list of things that we have to do, got to make time for this as well on weekends when there is skeleton staff anyway. (Nurse 7)*

Importance of team education

Education was perceived of great importance to successfully implement an enriched environment. Staff expressed that the interactive educational workshops that were provided prior to embedding the enriched environment created a basic understanding of the concept and awareness of the different components of an enriched environment. Education enhanced the capacity of staff to explain to patients and families why it is important to be active after a stroke. One staff member who commenced work in the acute stroke unit after the initial interactive workshops identified a lack of education for new staff members and perceived to be inadequately equipped to implement the intervention successfully.

> *I can't tell you about the different aspects of the intervention, not really, I don't think I was part of it enough. Not knowing enough about it as a new staff member. (Nurse 7)*

> *Making sure that everyone is on board with it and that everyone is willing to participate; because if you are not all going to participate and do it as a team, it is not going to work, so educating everyone- especially when there is new staff. (Nurse 9)*

Staff perceived that the interactive workshops led to consistency in information provision to patients and families, which contributed to successful implementation. One allied health staff member commented that medical staff were an important team player in creating an enriched environment.

Support from the medical team absolutely helped. The medical teams were to tell patients that it is important: 'you need to get up'. There is a brilliant program on the ward you need to attend to. Because they are the doctors, it is an important message. (Allied Health 3)

Yet, despite medical support of ward enrichment, staff acknowledged that education to patients and families was frequently required. Staff perceived that education should include what is expected regarding self-management and how patients and families can contribute to stimulation within an enriched stroke unit.

7.4.1.3 Theme 3: 'Keeping it going'

The majority of staff expressed during interviews their preference to maintain the enriched environment within the acute stroke unit for the long term. Staff perceived that the enriched stroke unit was beneficial for patient centered care and enhanced family involvement. However, staff experienced that it was easy to relapse into old work routine.

<u>Changing work routines challenging</u>

Staff repeatedly acknowledged that it was challenging to change work habits to incorporate a new and complex intervention. The consensus amongst nursing staff was that 'it takes time and effort' to change work routines, and they had to actively remind themselves to incorporate enrichment strategies.

From a nursing perspective, it is still quite difficult in regards to getting that changed behaviour, but certainly from family and that, I think we are getting there. It is going to be a slow process. (Nurse 6)

Staff expressed that continuous prompting and reminders were required during the implementation phase as enrichment was not part of their usual routine. To sustain an enriched environment in the long-term staff anticipated that leadership, continuous education, reminders, and team champions were key elements, as staff feared they would regress back into old work practice.

It took a long time for me to get into the habit of doing things with patients. It's just the prompts for me, somebody prompting or something to remind me. (Nurse 1)

The enriched environment intervention changed skills and competencies for some team members. Nursing assistants provided support to patients during interactive mealtimes in the enriched environment and were required to facilitate group communication. Staff indicated during interviews that nursing assistants were not sufficiently trained to perform these tasks and highlighted that targeted training for nursing assistants in facilitating group communication, and enhancing patient independence would support changing their work practices.

It's a lack of education. Some of them don't have the knowledge. Sometimes to help somebody you have to step back a little bit. (Allied Health 2)

Difficulties experienced by allied health professionals centered around family involvement, acknowledging that it was not routine practice to consistently involve family members in increasing patient activity in the acute stroke unit.

Family involvement was an aspect that is still not sufficient enough. That is a big allied health change. We tend to be focusing on our half hour of treatment and then we leave. We should work towards education and training of family in what they can do. (Allied Health 3)

Staff members indicated that the biggest drive to changing work practice was to achieve best patient outcomes. Positive feedback received from patients and families regarding the enriched environment reinforced staff to change work routine. Staff members perceived the unit as research driven and clinical staff wanted the trial to be successful so the team contributed to stroke care evidence. Staff anticipated that stronger evidence of better patient outcomes as a result of embedding an enriched environment in the clinical setting would motivate staff to sustain changed work practices.

Impacting contextual factors

The acute stroke unit prioritises admission of stroke patients to the unit. However, allied health staff found it challenging when small numbers of stroke patients occupied beds in the acute stroke unit, resulting in beds getting allocated to general medical patients. Allied health professionals in the stroke unit were attached to the stroke team and were not involved in patients from other medical teams. Fewer stroke patients present on the stroke unit made it difficult to organise meal and group activities.

> *We had some time in the enriched environment where we didn't have a lot of stroke patients. Where we were very slow, it makes it really hard to keep going. While when it is busy, when we have a lot of stroke patients, it's very easy. It's very easy to fill up the mealtimes and group sessions. (Allied Health 3)*

Many staff members commented that the acute stroke unit lacked a physical design to support an enriched environment. Shifting furniture in the therapy room on a daily basis to support mealtimes was annoying and time consuming. Staff indicated that optimising hospital design would contribute to implementing and sustaining an enriched environment. Recommendations for an optimal hospital design included inviting communal areas, therapy rooms equipped with stimulating resources, and green outdoor spaces.

> *I suppose just the setting up of breakfast, it got me sometimes. Because I'd come on night shift and you had to set up the breakfast tables, because it wasn't a permanent set up. (Nurse 9)*

> *It would be lovely if we had an outdoor area. Every hospital should have a sunroom where patients can get outside and get fresh air, that would be wonderful, and a lounge area, we unfortunately don't have that. (Nurse 5)*

Sustaining work practices

Staff provided advice on how to sustain the enriched environment model. Advice included consistency in leadership within senior allied health and nursing staff. Staff perceived that consistency positively contributed to team dynamics.

> *Especially from an allied health perspective you need to have consistency. You also need allied health assistants. They are imperative and I would love to see them across the board. (Nurse 6)*

Nursing staff anticipated that including enrichment strategies within stroke protocols of care would create an expectation for new nursing staff to incorporate stimulation for patients during their workday as routine practice. Other factors repeatedly mentioned during interviews to sustain work practice were continuous education, reminders and champions who drive the enriched environment.

> *One of the things we were thinking- the nursing staff have a standard stroke protocol, how we manage temperatures, blood sugars, blood pressure. And this is how we mobilise, this is what we do on interventions. Putting it in there that it is standard practice, that it is not additional; it is standard. (Nurse 1)*

> *I think it is ongoing education for nurse champions. Some people who say this is something that I believe in passionately and who want to see it happen. (Nurse 1)*

Cultural change within the team was identified as necessary to sustain the enriched environment, which staff members perceived as: ‘a slow process that takes time, is difficult at times, and the unit collective needs to drive this change’. Staff sensed that culture change was achieved when stimulating and activating patients on a daily basis became routine practice.

> *I think recognising that change is not always quick, that we keep doing it and we keep doing it and we just keep educating and we just keep moving forward then one day you will actually look back and go, this is just normal practice! (Nurse 6)*

7.5 Staff, patients and carers surveys

7.5.1 Methods

We developed a questionnaire to capture a broader perspective of the attitudes and views of allied health and nursing staff working in the acute stroke unit throughout the control and enriched environments cohorts. The staff questionnaire aimed to investigate the attitudes and views of a larger group of allied health and nursing staff than the semi-structured interviews. Questions targeted delivered patient care, quality improvements, team construct and workload. A brief questionnaire was used to explore the perspective of patients and carers to investigate their experiences and perceptions of the delivered rehabilitation in the acute stroke unit recovering within either the control (usual care) or intervention (enriched environment) rehabilitation model. Collecting staff views and consumer experiences is critical to enhancing our understanding whether an alternative model of enriched environment within the acute stroke unit is warranted to model consumer experience. Ethical approval to conduct designed surveys was obtained from The Prince Charles Hospital and the University of Queensland ethics committees (HREC/14/QPCH/21 and MREC/2014000371).

7.5.2 Design and participants

A written questionnaire was used for staff, patients and carers in the acute stroke unit within the usual care and enriched environment period. The aim was to have staff questionnaires administered during week 6 of the control and intervention phases; stroke survivors and carers questionnaires were administered at discharge from the acute stroke unit.

7.5.2.1 Staff

A research team member (JT) displayed memos in the stroke unit and personally invited all eligible nursing and allied health professionals working on the acute stroke unit to participate in the survey. Nursing staff members were eligible during the control phase if they expected to work in the upcoming intervention period, and were a permanent staff member within the acute stroke unit. We excluded staff members of the research team. The majority of allied health therapists were part of

the research team, so by exemption we invited rotating allied health therapists (n=2) to participate in the survey to get representation of therapists in the survey. These staff members were working in the acute stroke unit during the control period or within the intervention period. AHAs invited to participate in the survey worked across both periods. Participation in the study and answering the questionnaire was voluntary, anonymous and confidential. All participating staff members in survey signed the written consent form. (Appendix 12)

7.5.2.2 Patients and carers

All patients who provided consent to participate in the pilot study were also asked to consent to participate in the patient survey at the same time. When participants had identified a carer, we invited their carer to participate in the carer survey. Carers received participant information regarding the survey and were asked to sign the written consent form. (Appendix 12)

7.5.3 Survey development

7.5.3.1 Staff survey tool

The content of the survey was developed using background information related to staff surveys (National NHS Staff Survey Co-ordination Centre, 2012), and stroke care, rehabilitation and environmental enrichment as described in Chapter 2. We determined main topics of interest to be covered in the survey tool and defined related questions to each topic. A questionnaire was developed with ordinal 5-point likert-scale response options anchored from strongly agree to strongly disagree (Sullivan & Artino, 2013).

The staff questionnaire included 20 items and was divided into the following main sections: demographics, patient care, innovation, team relationships, competencies and workload (Appendix 13). Staff questionnaires were conducted in week 6 of the control (usual care) period, and repeated in week 6 of the intervention (enriched environment) period. Participating staff received an envelope, which contained 1) the staff questionnaire; 2) return envelope; and 3) a cover letter that explained procedure and aim of the survey. Staff were requested to return the questionnaire by week 9 in an allocated closed box in the acute stroke unit or to post it to the principal researcher of the study (Kelley et al., 2003).

7.5.3.2 Patient and carer survey tool

The patient and carer survey tool included a brief questionnaire using patient satisfaction information and previous patient and carers perspectives of stroke rehabilitation as mentioned in section 7.2 (Australian Commission on Safety and Quality in Health Care, 2010; Steering Committee for the Review of Government Service Provision, 2005). A questionnaire was developed with ordinal 5-point likert-scale response options anchored from strongly agree to strongly disagree (Sullivan & Artino, 2013). On the day of discharge from the acute stroke unit, patients and carers are occupied with discharge information, medication prescriptions and organising transport home. Hence, we made a deliberate choice to use a brief questionnaire to gather patients and carers experiences and perceptions.

The patient questionnaire included five questions. (Appendix 14) The main topics explored in the patient survey were whether patients perceived that rehabilitation had started in the acute stroke unit, and if sufficient stimulation was delivered. Participating patients received the questionnaire on the day of discharge from the acute stroke unit, and were asked to complete the survey and place it in an unmarked envelope. The principal investigator stored each questionnaire at time of collection within each respective participant folder.

The carer survey tool contained topics that focused on feelings of inclusion in the patient rehabilitation process, and if carers felt supported by the stroke team. The carer tool included six questions. (Appendix 15) Carer questionnaires were handed to the carers if they were present in the acute stroke unit on the day of discharge for the patient. The carer was asked to complete the survey and place it in an unmarked envelope. When a carer was not attending the acute stroke unit on the day of discharge, we posted the questionnaire to their home address and included a prepaid return envelope, which was addressed to the principal investigator of the study. The principal investigator stored the carer questionnaire at time of collection within the stroke patients' participant folder who had identified that carer.

7.5.4 Sample size and statistical analysis

A convenience sample for the staff survey was chosen. A sufficient sample size was deemed to one that represented a large proportion of the working staff population within the acute stroke unit. After exclusion of non-eligible staff (n=13), a target sample of n=36 was determined, representing approximately 82% of nursing and 40% of allied health staff.

Patient sample size in the surveys included all participants who consented to the pilot study, as providing consent for the survey occurred at entry to the pilot study. All carers who were identified by the participants were approached and included in a convenience sample to achieve a fair representation of the carers population.

We used simple descriptive analysis using frequencies of responses to each question. Missing data was excluded from analysis. To analyse between group differences, we performed chi square tests for each question in staff, patient and carers questionnaires.

7.6 Results

7.6.1 Staff

We invited a total of 36 staff members, 31 nursing staff and 5 allied health professionals. Twenty nurses (45 % of total nursing pool) and 5 allied health professionals (40% of allied health pool) agreed to participate and provided written consent. Response rate of staff returning the questionnaires was 92% (n=23) in the usual care period and 96% (n=24) in the enriched environment period. Across all staff questionnaires, 6 questions were left blank (0.6%) and excluded from analysis. Baseline characteristics of the participants are detailed in Table 7.4.

Table 7-4 Baseline characteristics of staff who participated in the staff survey (%)

	Usual care (n=23)	Enriched (n=24)
Gender		
Male	9	13
Female	91	87
Age		
<21	0	0
21-34	30	29
35-44	26	21
45-54	35	42
>55	9	8
Professional role		
Clinical Nurse	13	13
Registered Nurse	48	42
Enrolled Nurse	13	17
Assistant in Nursing	9	8
Allied Health Therapist	9	8
Allied Health Assistant	9	13
Years in profession		
< 1 year	4	0
< 2 years	17	12
2-5 years	35	42
5-10 years	22	21
> 10 years	22	25
Years on acute stroke unit		
<1 year	35	25
<2 years	17	21
> 2 years	48	54

Frequencies of response to individual questions are reported in Table 7.5. Statistical analysis showed that one question scored significantly different between groups. Significantly more participants agreed that stroke patients received sufficient stimulation to be active in the enriched environment period as compared with the usual care period (p=0.04). Further, a trend was found that more participants agreed that their source of job related stress was an excessive amount of work while working in the usual care period, as compared with the enriched environment period (p=0.05). See Table 7.5 for results regarding between group differences.

Table 7-5 Staff survey results: frequencies (%) and ChiSquare (p) for between group differences

Survey Question UC n= 23 EE n=24	Grp	Strongly agree	Agree	Neutral	Disagree	Strongly disagree	p value
Attitude, innovation and autonomy							
I feel I contribute to objectives of acute stroke care	UC EE	61 50	17 46	17 4	4 0	0 0	0.10
I think quality improvement initiatives are worthwhile	UC EE	65 67	26 33	5 0	4 0	0 0	0.51
I am able to provide suggestions how the team can improve effectiveness	UC EE	22 29	48 54	26 13	4 0	0 4	0.48
I am able to make decisions in my working capacity	UC EE	52 46	17 37	30 13	0 4	0 0	0.21
Patient care							
I have enough time to contribute to patient's rehabilitation goals	UC EE	0 4	44 25	17 54	26 12	13 4	0.07
Patients in general are satisfied with the stroke care provided	UC EE	26 38	61 54	13 8	0 0	0 0	0.67
I feel patients are getting sufficient stimulation to be active	UC EE	9 17	30 63	35 17	26 4	0 0	0.04
Team relationships and work satisfaction							
I feel accepted by other team members	UC EE	65 71	17 12	9 12	9 4	0 0	0.85
I take pride in the team I work with	UC EE	83 75	9 25	0 0	4 0	4 0	0.26
I enjoy the work I do	UC EE	74 83	13 12	4 4	4 0	4 0	0.70
My physical working conditions are good	UC EE	48 63	30 33	13 4	4 0	4 0	0.45
Staff generally cooperate in order to develop and apply new ideas	UC EE	39 46	48 46	9 8	4 0	0 0	0.76
I feel that team members help each other out when necessary	UC EE	52 63	35 33	13 4	0 0	0 0	0.52
I feel part of the team working toward shared goals	UC EE	57 63	22 29	17 8	0 0	4 0	0.55
Competence, skills and education							
I am provided enough information to do the work expected of me	UC EE	48 63	26 33	17 4	4 0	4 0	0.32
I feel I have the necessary professional skills to do my job	UC EE	46 58	36 42	14 0	0 0	4 0	0.19
I welcome new ideas and ways of looking at providing stroke care	UC EE	68 88	23 12	0 0	4 0	4 0	0.33
Impacts on work							
I have enough time to get the required job tasks done	UC EE	5 13	48 42	29 33	9 8	9 4	0.84
My source of job related stress is an excessive amount of work	UC EE	18 0	36 25	18 50	27 21	0 4	0.05
I feel confident to raise issues about my workload to my supervisor	UC EE	27 42	36 42	18 0	14 17	5 0	0.18

7.6.2 Patient and carers

The patient survey response rate was 97% (n=29) in the usual care group and 83% (n=25) in the enriched environment group. Reasons for missing surveys: in the usual care group one participant was palliated; in the enriched environment group 2 participants were palliated and 3 were unable to answer the questionnaire due to cognitive impairments. There were no unanswered questions across the entire patient sample. Frequencies in response are reported in Table 7.6. Frequencies showed that a significant larger proportion of the enriched group agreed that patients felt part of the team when compared to the control group (p=0.03). See results in Table 7.6.

Table 7-6 Patient survey results: frequencies (%) and ChiSquare (p) for between group differences

Patient Survey							
Survey Question UC n=29 EE n=25	Grp	Strongly agree	Agree	Neutral	Disagree	Strongly disagree	p value
I felt listened to and respected by staff	UC EE	66 56	31 40	0 4	4 0	0 0	0.47
I felt part of the team approach to my care	UC EE	52 72	41 16	7 12	0 0	0 0	0.03
I feel the rehabilitation process started in hospital	UC EE	41 64	59 36	0 0	0 0	0 0	0.10
I feel my time in hospital offered enough stimulation to assist my recovery	UC EE	45 68	52 32	0 0	3 0	0 0	0.18
I received adequate information regarding my stroke and care	UC EE	41 64	28 24	24 8	7 4	0 0	0.30

In the usual care group 22 participants had an identified carer, n=14 questionnaires were returned and n=8 were missing: response rate 64%. In the enriched group 20 participants had an identified carer, with n=10 questionnaires returned and n=10 missing: response rate 50%. There were no unanswered questions across the entire carer sample. On the day of discharge carers frequently remained at home, so we were unable to provide the survey personally to carers. Once we missed the carer on the day of discharge, we posted surveys to carers in the mail. However, it is plausible that this process may have resulted in unreturned carer surveys (usual care n=8 and enriched group n=10). No significant differences were found between groups. Overall carers were positive with the treatment and discharge preparation regardless of group, and felt included in the team. See Table 7.7 for results.

Table 7-7 Carer survey results: frequencies (%) and ChiSquare (p) for between group differences

Carer Survey							
Survey Question UC n=14 EE n=10	Grp	Strongly agree	Agree	Neutral	Disagree	Strongly disagree	p value
I was involved in the decision making for treatment and discharge plan	UC EE	14 40	57 40	29 10	0 0	0 10	0.24
I felt included in the team	UC EE	29 50	57 50	7 0	7 0	0 0	0.53
I felt emotionally supported by staff	UC EE	64 60	21 40	14 0	0 0	0 0	0.34
I received information regarding cause and nature of the patient's stroke	UC EE	43 30	50 60	0 10	0 0	0 0	0.48
I feel the time in hospital in hospital offered enough stimulation to assist recovery	UC EE	43 50	50 50	7 0	0 0	0 0	0.68
I feel confident in my preparation to manage on discharge	UC EE	21 30	57 60	14 10	7 0	0 0	0.81

7.7 Discussion

The semi-structured interviews showed that staff perceived that an enriched environment embedded in the acute stroke unit positively contributed to patients' recovery, and that patients' focus shifted towards recovery. Teamwork was perceived as an essential factor for successful implementation of an enriched environment in an acute stroke unit. Consequently, staff changes affected interdisciplinary team dynamics, which highlighted the importance of leadership and regular education to keep focus and momentum. Staff acknowledged that it was easy to relapse into old work routines and emphasised that team champions, reminders, consistency in staff and an optimal physical design were important contributors to sustain the enriched environment. Staff of the current study in the acute setting and the previous enrichment study in the sub-acute setting (White et al., 2014) both identified that the enriched environment provided increased opportunities for patients to be active. The results from the staff questionnaires also support the view that staff perceived the enriched environment intervention to increase stimulation for patients. Furthermore, questionnaires showed a trend that staff experienced greater '*excessive amounts of work'* within the control intervention, rather than within the enriched environment, which is an important finding for sustainability of this intervention. Patient surveys showed that patients in the enriched environment felt more part of the team when compared to the control group. Despite no differences between

groups across other questions in the surveys, it appeared that patients and carers accepted the enriched environment, as the majority of responses were positive.

The interviews showed that staff experienced that not all patients wanted to participate in communal activities, which made engagement of these patients in meaningful activities challenging. A recent systematic review that investigated experiences of stroke patients during acute and sub-acute rehabilitation found that patients felt bored, disempowered and wanted greater opportunities to engage in meaningful activity (Luker et al., 2015). Self-driven therapy activities (Harris et al., 2009), and therapy apps using tablets in stroke rehabilitation have been found to be well accepted at a patient level and have demonstrated their ability to increase therapy time and intensity of practice (Harris et al., 2009; Mallet et al., 2016; White et al., 2015a). Further development of self-driven interventions could strengthen meaningful individual enrichment and support activities outside therapy hours and during times of competing work priorities for staff. In addition, to facilitate individualised care within an enrichment model, early goal setting with patients and families could enhance staff focus towards meaningful activities tailored to each patient (Rosewilliam et al., 2011). Patient surveys showed that participants felt sufficient stimulation was offered within the enriched environment, but surveys were unable to inform differences between individuals, suggesting further research would be worthwhile to understand individual patient perceptions in more depth within the enriched environment in the acute stroke unit.

Teamwork was highlighted as a key factor to successfully create an enriched environment. This aligns with a previous report that emphasised the strong role of teamwork in implementing complex interventions in acute stroke units (Luker et al., 2016). Activities grounded in interdependence such as communal mealtimes have previously been identified to facilitate collaboration among team members from a variety of disciplines and contribute to building a team identity (Katz-Navon & Erez, 2005). High interdependence tasks promote collective-efficacy within a team, and support development of shared beliefs (Katz-Navon & Erez, 2005; Stajkovic et al., 2009). Our findings support this premise, where communal mealtimes required combined efforts of nursing and allied health professionals creating a feeling of ‘team effort and sharing of workload’. It is likely that lower ‘excessive amounts’ of work in the enriched environment, as expressed in the surveys, may be explained through clearly described staff responsibilities, and perceived teamwork and sharing of workload during interdependence tasks such as the communal meals within the enriched environment, as expressed by staff in the semi-structured interviews. Staff experienced that structured communal activities were easier to implement than individual enrichment strategies. This suggests that inclusion of interdependence activities within an enriched environment in an acute stroke unit could enhance team-efficacy.

Another important team factor emphasised in the semi-structured interviews was consistency in staff members. It was viewed as critical to create a team specialised in stroke care that can incorporate and sustain innovations such as an enriched environment. Staff surveys suggested that individual staff members felt that the team was collaborating to achieve patient goals. Previous research suggests that a perception of collective-efficacy within a team improves when individuals have a history of working together (Katz-Navon & Erez, 2005). Constructs such as collective-efficacy arise from individual staff members and through team processes as social interaction and interdependent task experiences transform collective-efficacy into a team level construct (Katz-Navon & Erez, 2005). In addition, specialisation in a particular patient population increases clinical efficiency within teams (Lemieux-Charles & McGuire, 2006), as well as cohesion and collaboration (Lemieux-Charles & McGuire, 2006). This suggests that successful implementation of complex interventions might rely on established team construct, and that team construct needs to be considered when designing implementation strategies (Lemieux-Charles & McGuire, 2006). Staff surveys indicated that the acute stroke team overall valued quality improvement and innovation. These views and attitudes may have contributed to the successful implementation of an enriched environment and needs to be considered when implementing the intervention across other acute stroke units.

Beyond team aspects, it appeared that not all staff members were equally involved in facilitating the enriched environment and that person-related factors such as motivation played a role in changing practice and behaviour. This is not surprising; people have different levels and types of motivational drivers. Staff perceived that team champions had an important role in facilitating staff during implementation of an enriched environment. Staff members who have high intrinsic motivation, where they perform a task for the satisfaction it provides (Ryan & Deci, 2000), might perform the champion role more successfully. A recent qualitative study found that team champions were considered to be facilitators during implementation of an intervention as they provided support and motivation to team members (Munce et al., 2017). In addition, the positive contribution of self-selected champions, who were highly motivated for their role, was also highlighted (Munce et al., 2017). Staff who are more extrinsically motivated, where they show a behaviour to receive some reward such as getting approval or avoiding feeling guilty (Ryan & Deci, 2000), are likely to respond better to clear transparent task descriptions and the influence of champions. Nursing staff indicated that incorporating ‘patient activity and stimulation’ as a daily care task within the nursing stroke care protocol could act as an extrinsic motivator to individual staff members. Adherence to a nursing protocol has previously been shown to be effective in changing nursing staff work routine (Brooks, 2004; Drury et al., 2014). Taken together, future

enriched environment studies should carefully consider implementation strategies that target both intrinsic and extrinsic motivators to maximise impact across the local team.

Allied health staff found it difficult to incorporate routines within their day to educate families to support their involvement in enriching the environment. While this change in work routine to educate families may take time, it highlights a potential mechanism to further enhance the efficacy of an enriched environment. Given patients spend little time with therapists in acute stroke units to start early rehabilitation (Bernhardt et al., 2007), it is important to look at alternative strategies to promote activity after stroke. Families have been found to be a resource efficient method that may augment intensity of rehabilitation activities (Harris et al., 2010; Vloothuis et al., 2016). Families are often willing to be involved in providing activities to stroke patients, but factors such as work commitments and lack of confidence impact their ability (Galvin et al., 2008). Carer surveys showed that carers felt supported and included in the team within the enriched environment. While carers have expressed they want to actively contribute to the recovery process (Luker et al., 2017), our brief survey was unable to determine if carers perceived their involvement was sufficiently addressed within the rehabilitation process. Quantitative data exploration confirmed that 'visitor involvement' (Section 6.4.3) contributed to an increase in physical and cognitive activity. Availability of information brochures for patient and families, self-driven exercise programs and conjoint activity opportunities with staff while in the acute stroke unit may enhance family involvement. Utilising a theory of change model (Grol & Grimshaw, 2003) including barrier and facilitator exploration with allied health staff and families, may provide further insight into how family involvement can be promoted, as well as future in-depth interviews.

Contextual factors such as hospital design were highlighted as important in facilitating and sustaining an enriched environment from an organisational perspective. There remains limited evidence available about which hospital design has a positive effect on patient activity levels. Further studies investigating optimal health design in acute hospitals to support stroke recovery are needed and need to include consumer and clinician perspectives on how the physical build design can promote rehabilitation and recovery after stroke.

Finally, all staff highlighted during interviews that change management strategies such as knowledge of the enriched environment concept, transparent responsibilities, reminders, feedback, drivers and education were important to keep new and existing staff members involved and educated. Developing online mandatory educational packages to educate new staff members might be beneficial to support the enriched environment intervention long-term. It is likely that a variety of selected change management strategies to embed an enriched environment contributed to successful translation of the enriched environment.

A strength of our qualitative study included representation of a sample of staff involved in the daily delivery of the enriched environment intervention. In addition, interviews with new staff who became part of the team during the recruitment phase provided additional valuable information for future clinical translation. However, the semi-structured interviews had several limitations. First, we focused only on staff perception and experiences and did not include patients or carers. Second, our study was not underpinned by a specific qualitative methodology, involved a small sample and was conducted in one acute stroke unit limiting applicability of findings. Third, it appeared that data saturation was reached, but it is possible that a larger study sample could have led to additional perspectives being raised. Fourth, participant responses to questions may have been coloured as they were aware that the Principal Investigator would read the transcripts of the interviews. Fifth, our interview schedule did not include detailed questions regarding the different elements of the intervention. We therefore recommend that future studies inquire in more detail about strengths and weaknesses of the intervention. Last, participants were only interviewed once after recruitment was finalised limiting evaluations of experiences and perceptions throughout the course of implementing the enriched environment.

A strength of the staff questionnaire was that we gathered information from a larger pool of staff members, as the enriched environment intervention had a substantial impact on clinical practice. However, only two rotating allied health therapists were included in the survey, as most therapists were research team members, which makes it difficult to interpret how the enriched environment made an impact on allied health professionals. Even though that patients and carers' questionnaire were brief; they indicated that consumers felt positive with regards to the enriched environment intervention. However, no specific information was captured to what extent patients themselves and carers contributed to the patients' activity levels. This gap needs to be considered in future studies and further studies are recommended to investigate patients and carers' experiences and perspectives of an enriched environment, and how consumers can be empowered by the health care team to drive their own recovery within an enriched environment.

7.8 Conclusion

This mixed methods investigation of our enriched environment study showed that staff in an acute stroke unit perceived an enrichment model to have a positive effect on patient recovery and family involvement. They indicated that the enriched environment made the interdisciplinary team more visible and that structured tasks involving interdependence of professional streams facilitated

teamwork and contributed to team identity. Optimal hospital design and access to a variety of self-driven exercise interventions and resources were perceived to support embedding and sustaining an enriched environment. Lastly, prolonged use of change management strategies to support individuals in adapting and maintaining new work practices was deemed critical in achieving a long-term culture change on the unit. Staff surveys suggested that the enriched environment did not increase workload in staff. Patients and carers' experiences appeared to be positive towards the enriched environment in acute stroke unit. However, caution needs to be taken with the interpretation as no in-depth information was gathered from patients and carers.

Chapter 8 will provide a summary of the findings of the thesis, implications for clinical practice and directions for the future.

Chapter 8 Discussion and conclusion

8.1 Overview

There is strong evidence showing that stroke survivors are inactive and alone in the early phase post stroke (Fini et al., 2017; West & Bernhardt, 2012). Stroke clinical guidelines around the world recommend early rehabilitation after stroke to promote recovery, with evidence suggesting that higher levels of activity lead to better functional outcomes (Schneider et al., 2016; Veerbeek et al., 2014). Promoting activity early after stroke is further supported by preclinical evidence that suggests there is a critical window of heightened neural repair that exists early after stroke (Biernaskie et al., 2004). Taken together, this build the rational for investigation and development of innovative interventions to increase activity levels in stroke survivors early after stroke. An enriched environment is one such a possible innovative intervention.

In animal models an enriched environment refers to housing conditions that stimulate physical, social and cognitive activity in rodents compared with standard housing (Nithianantharajah & Hannan, 2006). Rodent models post stroke have shown that an enriched environment leads to improved functional outcomes, mood and exploratory behaviour (Janssen et al., 2010). Initial clinical translation of an enrichment model was undertaken in the subacute inpatient rehabilitation setting (starting on average >14 days post stroke). Provision of stimulating resources saw stroke survivors 1.2 times more active in the enriched environment as compared to the standard rehabilitation unit (Janssen et al., 2014b). Until now, an enriched environment has not been translated to the acute stroke unit (starting within 24-72 hours post stroke). The acute stroke unit is a unique health environment where stroke survivors are more physically dependent, in a higher emotional state and overall length of stay is shorter.

Thus, the primary aim of this thesis was to determine if it was feasible to translate an enriched environment into the acute stroke unit, and to determine if an enriched environment increased physical, social and cognitive activity levels in acute stroke patients. This chapter provides a summary of findings of the different studies included in this thesis and outcomes. It also presents clinical implications, strengths and limitations of the thesis, as well as a discussion of future directions to move application of the enriched environment forward in the clinical stroke settings. The thesis will end with conclusions.

8.2 Summary of findings

This thesis explored if embedding an enriched environment in an acute stroke unit was feasible and had an effect on physical, social and cognitive activity levels of stroke patients. A before – after pilot study examined the effect of embedding an enriched environment on activity levels, adverse events and functional outcomes in acute stroke patients (Study 1). To understand if the enriched environment intervention could lead to sustained effects on activity levels, a follow up group was observed 6-months post initial implementation of the intervention (Study 2). The third study investigated the rich observational data collected in the pilot study in further detail to understand timing and nature of patient activities observed to guide future refinement of the enriched environment model (Study 3). The final study used mixed methods to understand how the enriched environment was perceived and experienced by staff using semi-structured interviews, and to determine the perceptions of staff, patients and carers on both interventions using surveys (Study 4).

8.2.1 Study 1: Embedding an enriched environment in an acute stroke unit

The first step to an enriched environment in an acute stroke unit was selection of optimal enrichment strategies that aligned with preclinical models of environmental enrichment. A detailed description of the enriched environment intervention was described in an intervention protocol. Three key intervention strategies were defined:

1. Creating a stimulating environment through provision of stimulating resources in communal areas and at the patient bedside; opportunity to access daily communal mealtimes and group activities on weekdays;
2. Providing patients and families with information explaining how patients and families can contribute to increasing patient activity levels outside therapy hours; and
3. Using change management strategies to support staff in changing work routines to facilitate uptake of an enriched environment intervention within usual staffing levels.

Our primary aim was to determine whether an enriched environment in an acute stroke unit increased activity levels in stroke survivors compared to the usual stroke unit environment (control). Secondary aims were to investigate whether an enriched environment resulted in fewer adverse events, and improved mood and functional outcomes compared to the usual stroke unit environment (control).

A before - after pilot study was performed utilising behavioural mapping to estimate percentage a patient was observed in physical, social and cognitive activity, as well as body position, location and people present with the patient in a control group and enriched environment intervention group. Stroke patients were observed across three days within the first 10-days post stroke every 10 minutes from 7.30am till 7.30pm. We used an adverse event registry, functional and mood outcome measures on admission and discharge from the acute stroke unit, and determined disability at 3-months post stroke using a telephone follow up call.

This study showed that the enriched environment group spent a significant higher proportion of their day engaged in 'any' activity (71% vs. 58%, p=0.005) compared to the control group. Stroke patients in the enriched group showed they were more active in the domains of physical (33% vs. 22%, p<0.001), social (40% vs. 29%, p=0.007) and cognitive (59% vs. 45%, p=0.002) activity when compared to the control group. Furthermore, patients spend less time in supine body position (45% vs. 68%, p<0.001), in their room (79% vs. 95%, p<0.001) and being alone (51% vs. 59%, p= 0.035) in the enriched environment compared to control. There were no differences between groups for functional outcomes or mood at time of discharge from the acute stroke unit, or at 3-months follow up. The enriched group experienced a significant reduction in adverse events, but no differences in serious adverse events were experienced when compared with the control group; demonstrating the intervention is safe to deliver early after stroke in the acute stroke unit. (See Appendix 11 Frequency and type of adverse events experienced in the usual care and enriched groups)

The positive finding that the enriched environment increased activity levels in acute stroke patients without the need for increased staffing levels suggest that the enriched environment can be integrated in an acute stroke unit with limited recurrent costs. As acute stroke patients have consistently been observed to be inactive in the early phase post stroke, enriching the acute stroke unit environment can stimulate increased activity in hospitalised acute stroke patients.

8.2.2 Study 2: measuring sustainability of an enriched environment

Once a new intervention has been embedded and tested it raises the question if the intervention is sustainable over a prolonged period of time. As the enriched environment intervention has an impact at the level of the individual, team and organisation, maintaining such a complex intervention requires a sustained change in clinical practice. After completion of the initial pilot study, staff were informed that the enriched environment program would be continued in the acute

stroke unit. However, change management strategies and staff support were withdrawn. The aim was to determine if activity levels were sustained 6-months post implementation of an enriched environment in acute stroke unit.

A new cohort of stroke patients was recruited to a follow up group 3-months post completion of the enriched environment intervention group. Results showed that activity levels on the unit were sustained in patients enrolled in the follow group. Patients showed no difference in proportion of their day spent in 'any' ($p=0.120$), physical ($p=0.114$), social ($p=0.56$) and cognitive ($p=0.124$) activity when compared with the enriched environment intervention group. However, a decline in each activity domain was noted and patients in the follow up group spent more time in a supine position ($p<0.001$) or in their room ($p=0.001$) compared to the enriched environment intervention group. No differences were found for proportion of time patients were 'alone' between groups ($p=0.120$).

The maintained activity levels 3-months post completion of the enriched environment intervention showed that the primary outcome of activity levels was sustained. However, stroke patients showed a pattern of spending more time back in their rooms and in bed, which suggests that sustained clinical practice was not yet achieved at that time point. Withdrawal of change management strategies that supported staff in changing their work routine likely contributed. Furthermore, staff changes may have occurred in the time period after completion of the intervention group, which also may have impacted to the inability to sustain clinical practice. The findings in this study align with evidence that alleviate that continuous staff education is an import factor to promote sustainability (McCluskey & O'Connor, 2017).

8.2.3 Study 3: Understanding how the enriched environment impacted on activity levels

Our enriched environment intervention included a variety of enrichment strategies to stimulate activity in acute stroke patients. The intervention offered access to structured communal mealtimes and group activities, provided stimulating resources at the patient bedside, and patients and families were encouraged to increase their own activity outside therapy hours. While results showed that patients in the enriched environment increased their activity levels, this was a novel intervention. Therefore, it remains unknown if increased patient activities were favourable activities such as walking, or negative activities such as watching television. Furthermore, as the majority of stroke patients in an acute stroke unit were dependent on staff assistance to undertake an activity

comparing the amount of assistance provided by staff during the enriched environment and control period is an important consideration for sustainability of the enriched environment. So, aims were to understand how the enriched environment had an effect on timing and nature of patient activity levels and to determine the amount of staff assistance provided during patient activities.

The observational data gathered during the initial pilot study was used for in-depth analysis to probe for differences. We examined predefined time periods, nature of activities performed and amount of staff assistance provided to patients to undertake activities across the control and enriched environment intervention groups. Results showed that 'any activity' increased during scheduled structured communal activity time ($p<0.001$), weekday non-scheduled activity time ($p=0.007$) and on weekends ($p=0.018$); with no differences observed between groups after 5pm ($p=0.324$). The nature of activities that increased during the enriched environment compared to control were upper limb ($p<0.001$), communal socialising ($p<0.001$), listening ($p=0.007$), and iPad activities ($p=0.002$). Results suggest that communal activities and provision of stimulating equipment were effective enrichment strategies to facilitate patient activity in the early phase after stroke. Communal activities offered patients frequent opportunities to mobilise from the bedroom to the communal space and undertake social activities. Important to note is that activity levels were also higher on weekends suggesting that patients and families themselves contributed to increased patient activity levels outside therapy hours, as reduced staffing is available on weekends. Amount of staff assistance delivered to support patient activity showed a non-significant difference between groups with a trend to increased staff assistance delivered during physical patient activities in the enriched group (control group 4.5% vs. enriched group 6.6%, $p=0.055$).

The enriched environment intervention was a complex intervention. Further analysis of the observational data showed how the enriched environment promoted patient activity in an acute stroke unit early after stroke. The study did not provide insight if patients performed activities that addressed their specific impairments and/or activity limitations, or resulted in enhanced participation.

8.2.4 Study 4: Investigating staff, patients and carers experiences

To understand how the enriched environment intervention facilitated a change in activity levels a process evaluation is recommended (Moore et al., 2015). Exploring how staff, patients and carers perceived and experienced the enriched environment intervention is a critical element of process evaluation (Moore et al., 2015), especially as the enriched environment required increased

collaboration between nursing staff and allied health professionals to implement communal meals and group activities and to achieve smooth delivery of care. Semi-structured interviews and surveys with staff were performed to gather their perspectives and experiences of the intervention. Furthermore, questionnaires for patients and carers were used to probe acceptance of the intervention. Aims of this study were to understand perception and experiences of nursing staff and allied health professionals involved in implementing an enriched environment in an acute stroke unit and to determine if patients and carers accepted the novel intervention.

A descriptive qualitative approach using semi-structured interviews and written questionnaires were used. Semi-structured interviews with nursing and allied health staff revealed three main themes. First, 'the road to recovery had started' which showed that focus in the acute stroke unit had shifted from acute care towards recovery. Staff expressed that increased patient activity and improved wellbeing was observed in stroke patients within the enriched environment and perceived that the increased activity levels positively contributed to the patients' recovery. Second, 'it takes a team' to create an enriched environment within an acute stroke unit. Staff experienced that interdisciplinary teamwork was more pronounced within the enriched environment and that positive relations and dynamics were essential for successful embedding of an enriched environment. Staff also emphasised the importance of education as an important enabler for enrichment. Third, 'keeping it going' was perceived as challenging. Staff expressed that it was easy to relapse back to old work routines. Contextual factors such as physical ward design, and numbers of stroke patients in the acute stroke unit impacted on staff their ability to keep the intervention going. Staff emphasised that to sustain the intervention prolonged change management strategies were needed. The results of this study highlight that teamwork and staff involvement were a key factor for successful implementation of an enriched environment as the majority of patients in an acute stroke unit are dependent on staff assistance to access meal times, group activities or stimulating equipment.

Staff surveys suggested that a large proportion of staff agreed that in the enriched environment stroke patients received increased stimulation to be active compared to the control period. Furthermore, staff reported reduced levels of stress in the enriched period related to amounts of work. This suggests that the enriched environment did not increase stress related to increased work amount, but rather decreased it. The majority of explored domains in the questionnaire showed no differences between the enriched environment intervention group and the control group.

Patient questionnaires showed that patients were positive about received care and therapy delivered in the acute stroke unit in the enriched and control group. Patients in the enriched group indicated that they felt more part of the team as compared to the control group. Carers' surveys

showed generally positive feedback with no differences between groups. Questionnaires for patients and carers were brief and caution needs to be taken with interpretation of their results.

Table 8-1 Summary of thesis findings

- An enriched environment embedded in an acute stroke unit may increase 'any', physical, social and cognitive activity levels in acute stroke patients (Study 1).
- The enriched environment may reduce adverse events in acute stroke patients (Study 1).
- Embedding an enriched environment in an acute stroke unit leads to a sustained increase in activity levels of acute stroke patients (Study 2).
- Scheduled communal activities e.g. scheduled breakfast and lunch, and provision of stimulating resources showed a large effect on promoting patient activity within an enriched acute stroke unit environment (Study 3).
- Staff supported the enriched environment, as staff perceived that the intervention promoted recovery in acute stroke patients (Study 4).
- Staff suggested that interdisciplinary teamwork was a key element to successful implementation of an enriched environment (Study 4).
- Prolonged use of change management strategies to support staff in changing clinical practice may benefit sustainability of the enriched environment intervention (Study 2 and 4).
- Patients and carers appeared to accept the enriched environment intervention (Study 4).

8.3 Clinical implications

8.3.1 What evidence is available?

So, should we start implementing enriched environments in acute stroke units? The robust evidence of positive effects gathered in preclinical models of environmental enrichment (Janssen et al., 2010) in combination with positive results achieved in the first small to medium sized clinical enriched environment studies (Janssen et al., 2014b; Khan et al., 2016; Rosbergen et al., 2017) demonstrate that there is considerable cause for optimism that an enriched environment may have clinical benefit to stroke rehabilitation and recovery. The studies completed within this thesis showed that an enriched environment in an acute stroke unit can increase activity levels in stroke survivors. However, research underpinning clinical application of environmental enrichment in human stroke populations is in its infancy, as very limited data is available on patient relevant outcomes such as

functional status, quality of life and participation outcomes. Before widespread uptake of environmental enrichment can be recommended stronger evidence is needed.

Until now clinical studies have explored the impact of an enriched environment on activity levels, adverse events, mood and functional outcomes in human stroke population. Janssen et al. 2014 showed that conceptual translation of environmental enrichment in animal models to the clinical subacute inpatient rehabilitation setting increased total, physical, social and cognitive activity in stroke survivors (n=29, 15 in the enriched group). Our study in an acute stroke unit showed similar results with increased activity levels observed in stroke survivors (n=60, 30 enriched group) when timing of enrichment was initiated early after stroke (>24hours post stroke). Furthermore, the enriched environment intervention was sustained to increase activity levels 6-months post implementation when staff supports were removed, to more closely replicate usual care (n=30 follow up group). Khan et al. 2016 used the 'Activity Arcade' approach in addition to personal and communal enrichment in the subacute inpatient rehabilitation setting and showed a significant positive effect on function and reduced depression scores in stroke survivors (n=104, 52 enriched group) at discharge from the subacute rehabilitation unit, however no differences between groups were maintained at 3-months post stroke. This study did not quantify individual patient activity, so it is unknown if the intervention had an effect on activity levels. Each of these studies made specific contributions towards providing evidence that clinical translation of an enriched environment in acute and subacute inpatient rehabilitation units may be safe, feasible, can increase a variety of activities, and may promote functional recovery after stroke. These promising results show that an enriched environment may be an adjunctive intervention to promote recovery after stroke and mandate future studies that investigate motor, speech and cognitive recovery, as well as the effect of environmental enrichment on mood and quality of life.

8.3.2 Clinical enriched environment designs

For decades, stroke survivors have shown low levels of physical activity and spend a large amount of time alone in acute and subacute inpatients rehabilitation units (Fini et al., 2017; West & Bernhardt, 2012). The environment surrounding the stroke survivor is in constant interaction with the stroke survivor; creating a stimulating environment may be an adjunctive method to increase activity levels in stroke survivors. This raises the question how an enriched environment needs to be tailored to the specific health care setting and patient population. The enriched environment in the subacute inpatient rehabilitation setting by Jansen et al. included environmental driven resources,

and staff only encouraged stroke survivors to utilise resources when they were observed to be inactive. However, in the studies of this thesis, a deliberate choice was made to include personal and communal enrichment resources, plus communal mealtimes and group activity sessions that did require staff involvement. Dependency in mobility was high in stroke survivors in the acute stroke unit setting (88%), which meant that to enhance activities away from the bedside, stroke survivors relied on mobility assistance. Offering daily communal meal and group activities made it possible to stimulate stroke survivors at a social level and to move away from the bedside in the acute phase after stroke. This shows that staff encouragement and/or assistance to enhance access to enrichment opportunities may be different dependent on care setting and patient population. Taken together, it appears that the context of the care setting and characteristics of the patient population demand tailoring of the enriched environment model, and that these factors need to be considered when environmental enrichment may be translated to other clinical areas e.g. dementia, geriatric and acute medical units.

8.3.3 Environmental enrichment - a complex intervention

Implementation of the enriched environment in the acute stroke unit involved change in behaviour of multiple disciplines (at least 6), managers, and hospital organisational processes. Changing clinical practice in a complex setting such as the acute stroke unit is difficult. Complex interventions have been defined by Redfern et al. as educational/ psychosocial interventions aimed to change knowledge, beliefs or behaviours, and complex interventions frequently target multiple components and outcomes (Redfern et al., 2006). This study included the use of change management strategies to support staff in changing their clinical practice to adapt to the 'new enriched environment'. As the intervention was embedded within available staffing levels we used education, identification of barriers and enablers, feedback, reminders and nurse champions to support staff to change clinical practice (Grol & Grimshaw, 2003). Staff interviews confirmed that staff perceived the educational sessions as critical to support their ability to promote activity in stroke patients as these sessions increased their knowledge to explain why activity after stroke is important. It appears that these strategies were effective to implement a change in staff behaviour. When change strategies were removed, pleasingly activity levels measured 6-months later in the sustainability group were maintained, however, a trend in activity decline was visible and patients had returned back to spend the majority of time in bed and/or in their room. Staff emphasised that sustaining a new practice was challenging, and factors such as change in team members (who were not exposed to the educational workshops) and clinical priorities made sustaining new practice

difficult. In order to facilitate sustainability nursing staff recommended to prolong change management strategies and to include activity promotion in routine nursing protocols to facilitate regular patient activity. Inclusion of activity promotion in nursing protocols can also facilitate the notion that stroke survivors view nursing staff as key rehabilitation staff, as a recent study reported that stroke survivors were unsure about the role of nursing staff in the rehabilitation component (Loft et al., 2017). In this thesis, we withdrew all change management strategies after the pilot study. Prolonging regular audits of performance with targeted feedback and education to staff, has shown to enhance sustainability of clinical practice (Vratsistas-Curto et al., 2017). Thus, in clinical applications of environmental enrichment in an acute stroke unit staff support and clear responsibilities are critical. Exploring effect of prolonged change management strategies including education and feedback on performance, and approaches that facilitate nursing staff to routinely promote activity are recommended in future studies.

The enriched environment was delivered at a ward level. Implementation of innovations such as an enriched environment are challenging in settings such as the acute stroke unit, which are fast paced and where patient stay is short in nature. Interviews with staff in this thesis showed that teamwork was essential for successful implementation of an enriched environment. Previous studies also have reported that teamwork is critical in successful quality improvement. Characteristics highlighted included: 1) composition of the team; 2) staff collaboration; 3) stability of team members; 4) manageable workload; and 5) presence of a team leader and specialist clinical leadership (Schouten et al., 2008) (Lemieux-Charles & McGuire, 2006). Leadership that promotes the need for activity early after stroke, and supports patients to spend time away from the bedside are critical elements related to an enriched environment. Patients and families are strongly influenced by the message they receive from the leading physician, and it is important that the treating multidisciplinary team delivers consistent information. The medical team involved in the enriched environment in the acute stroke unit actively supported the enriched environment and encouraged stroke survivors to participate in enrichment activities. This resulted in frequent situations where the patient was away from the bedside during ward rounds, which required the medical team to be flexible. Thus, successful clinical implementation is dependent on individual staff, team and leadership factors and future design of a large efficacy trial needs to pay attention to staffing and team factors.

Evaluation of complex new interventions is recommended to improve development of the intervention (Moore et al., 2015). Evaluation of our pilot study showed that scheduled communal mealtimes and group activities had the largest overall effect in increasing patient activity. AHAs and nursing assistants performed new skills and competencies in facilitating communal mealtimes.

When the enriched environment was developed, staff in this unit agreed that therapists would organise a daily list of patients suitable for communal mealtimes, and therapists and AHAs together would mobilise patients to the communal mealtime area. AHAs and nursing assistants would then supervise patients during communal meal sessions and facilitate interactions. However, in the 'old stroke unit environment' these professionals were not involved in supervising and facilitating group activities. Interviews suggested that provision of training to these staff members to expand competencies and skills may benefit the quality of communal mealtimes. Professional development of these staff members is needed as they receive rehabilitation education infrequently (Lawrence & Campbell, 2018). Training could focus on enhancing skills in facilitating group communication, independence in eating and activity promotion. Thus, future implementation of an enriched environment needs to consider the impact of the intervention on work content at an individual staff level and consider if education is needed to support development of new skills and competencies.

The enriched environment concept was developed in animal models, but nature of human engagement means that the enriched environment intervention had the potential to be enhanced. In stroke survivors, awareness can be created that rehabilitation after stroke is a critical factor to enhance recovery, which is not possible in animals. Heightened awareness of stroke survivors within the enriched environment intervention package may strengthen the intervention. In this study, we provided patients and families with a brochure and explained why activity after stroke is important to create understanding of the positive effect of activity after stroke on recovery. Providing information and creating awareness in patients and families directly at the start in their recovery journey may facilitate behaviour in stroke survivors that supports their recovery. As stroke is a condition with a life-long effect, it is critical that stroke survivors and families are equipped to self-manage and drive their own recovery. Patient and carer surveys showed that patients and carers were positive about all engagement in either the enriched or control group, which shows that it might be worthwhile to understand if this education in the enriched environment changed their understanding of what they should do to aid recovery. However, we did not explore if patients and families grasped the content and if provision of this brochure facilitated activity levels. The timing, amount, need for detail and method of information have been identified important factors for receiving and understanding health information for patients and carers (Eames et al., 2010). Furthermore, we did not investigate patients and families' expectations regarding activity early after stroke. Expectations explored in acute general medical patients found that a large proportion of patients expected to remain in bed while in the acute medical ward (Cattanach et al., 2014). Furthermore, emotional factors such as anxiety after stroke may result in a preference by patients and their carers to stay in bed (Kroeders et al., 2013). We used a variety of personal and communal enrichment activities. We did not gather information about how stroke survivors perceived these

activities or their preferences for activities in a structured way. To implement an enriched environment in the acute stroke unit these are important consumer elements to consider. Future research is needed to 1) explore patient and families' expectations and preferences regarding activity early after stroke; and 2) determine the effect of creating awareness in patients and their families of benefits of activity on recovery early after stroke, and investigate if these factors contribute to enhance activity in an enriched environment model.

Finally, preclinical research has established that an enriched environment in rodents post stroke promotes functional recovery. The first translations of an enriched environment into clinical stroke settings showed increased activity levels in stroke survivors, as well as some studies reporting positive effects on function, depression and adverse events. This suggests that implementation of an enriched environment as an adjunctive intervention to promote stroke recovery in the clinical inpatient rehabilitation setting warrants further exploration.

8.4 Strengths and limitation of the thesis

8.4.1 Strengths

This thesis is the first to develop and implement an enriched environment intervention in the acute stroke unit. The novel intervention was successfully implemented with no increase in staffing in the acute stroke setting. The acute stroke unit setting is a challenging environment with medically acute and dependent stroke patients. In this thesis we probed the impact of an enriched environment on patient activity levels, patient functional status, anxiety and depression, staff/ patients and carers perceptions and more deeply interrogated the data to determine the impact on the nature and timing of patient activities. This resulted in a rich and robust conceptualisation of an enriched environment in the acute stroke unit. We included three phases in the study: usual care (control), enriched environment and a sustainability (follow up) phase. This design provided a large amount of observational data obtained with behavioural mapping with few missing data and data analysis presented robust evidence in patients' activity levels in the acute stroke unit. Furthermore, the information gathered in this thesis helped to understand which contributors were critical in clinical translation of an enriched environment and in sustaining environmental enrichment. Perceptions and experiences were explored from staff and included nursing and allied health professionals, which provided new insights and information how the enriched environment impacted on multidisciplinary teamwork. Finally, sustainability of the enriched environment intervention had not

previously been explored and adds novel knowledge to the translation of an enriched environment. This thesis has built on previous preclinical and clinical evidence moving the enriched environment concept forward as a possible adjunctive intervention in post stroke rehabilitation.

8.4.2 Limitations

The thesis has several limitations. The study was conducted in one acute stroke unit and had a modest sample size of 90 overall, which limits generalizability of the enriched environment intervention. However, the broad inclusion and minimal exclusion criteria chosen (premorbid mRS ≥3, extensive psychiatric history and concurrent rapidly deteriorating illness) resulted in a heterogeneous study sample that provided a good representation of stroke patients who normally recover in an acute stroke unit. Factors that were more difficult to control in the study execution included team dynamics, leadership qualities, and physical design characteristics of the unit, and these factors may have impacted on study outcomes. In future larger multi-site studies a stepped wedge cluster randomised trial design may need to be considered. This design controls to some extend for possible contaminating factors as baseline and intervention data is collected from each participating site (Hemming et al., 2015).

This study did not include in-depth interviews with patients and carers. In the acute phase after stroke, patients and families are experiencing an emotional time, which supported the choice for using a brief questionnaire. The questionnaire indicated that stroke patients and families accepted the intervention, but provided limited in-depth information to the study team. Survey data was unable to indicate if stroke severity had an impact on patients' ability to access available enrichment activities on the ward. Patient perception and experience have previously been explored during acute and subacute inpatient rehabilitation (Luker et al., 2015), as well as within an enriched environment in the subacute inpatient setting, which provided useful information (White et al., 2015b). However, no in-depth exploration has occurred yet of patient and family experiences and perception of an enriched environment in the unique acute stroke setting. Thus, exploring how acute stroke patients and their families experience available activity opportunities at the bedside and in communal areas, and how patients and families contribute to drive their own recovery within an enriched environment may shape and strengthen the enriched environment intervention.

Further, the before- after study design resulted in two cohorts treated at different time points in the year and seasonal aspects may have impacted on results. However, during the pilot study no memorable changes in health policies were made. Changes in staffing did occur during the study

time period with new graduated nursing staff commencing in January, which occurred every January in the acute stroke unit and the rest of the hospital. The commencement of new staff that happened in the middle of the enriched environment period did not favour the enriched environment period as these staff members were not educated in the enriched environment concept and were largely occupied in achieving competencies in delivering stroke care making implementation of the enriched environment extra difficult. Change in staffing has previously been emphasised as a challenging factor in undertaking a clinical trial, and ongoing education and support was advised (Luker et al., 2016). This study had not enough patients to stratify according to stroke severity, and was therefore unable to indicate if environmental enrichment was more beneficial for mild, moderate or severe acute stroke patients. It is plausible that moderate severe stroke patients experienced greater benefit than very mild stroke patients, as moderate severe stroke patients had greater length of stay and therefor prolonged exposure to an enriched environment within the acute stroke unit.

Lastly, the intervention showed that activity levels were increased in all activity domains. However, it is unknown if performed activities were tailored to the stroke patients' specific impairments and activity limitations or related to their goals. It is likely that therapists were pragmatic and offered activities e.g. GRASP when a patient demonstrated upper limb problems, however the study was unable to report if activities observed were matched to the needs of the individual. Inclusion of wearable accelerometers to measure specific activity may provide an opportunity to probe deeper in certain activity domains e.g. accelerometers for upper limb activity. Future studies that target activities to individual needs and goals, and explore if tailored activities result in improved outcomes at function or activity levels may strengthen environmental enrichment.

8.5 Directions for further research

This thesis added new knowledge and evidence that supports that an enriched environment may have clinical application in stroke recovery, and highlighted areas for future research. The next section will outline a summary of future directions and research opportunities to guide clinical translation of an enriched environment in human stroke population.

8.5.1 Future enriched environment models

8.5.1.1 Alignment of preclinical and clinical models

When a well-investigated concept is taken from the bench to the bedside, it is critical to constantly reflect if conceptual alignment is maintained. In the majority of preclinical enrichment studies, the environment was organised to offer physical, cognitive and social stimulation 24-hours a day within the home cage (Hannan, 2014), which is similar to how stimulation was offered in this study in the acute stroke unit setting. Furthermore, social stimulation is an important component element of the enriched environment concept in preclinical enrichment models where larger groups of rodents are housed continuously together (Corbett et al., 2014). To support social activity alignment in the clinical acute setting, scheduled communal mealtimes and group activities allowed stroke patients to get exposure to social encounters but these activities were only available on weekdays and not all stroke survivors enjoyed these activities. Analysis showed that scheduled communal activity was the only type of enrichment strategy that significantly increased social activities in stroke survivors. Increasing variety in communal activities such as daily morning and afternoon tea in designated areas or outdoor activities are opportunities to explore. Engagement of stroke survivors in these types of activities will likely require assistance from staff. Expanding scope of AHAs in organising and supervising communal sessions may be plausible. AHAs have previous shown to be a critical health professional in establishing an 'Eat Walk Engage Program' in elderly people admitted to an acute general medical ward (Mudge et al., 2015), which our study confirmed. Furthermore, as shortage of therapists is expected in the future with the ageing and growing population in Australia, novel models of care will be needed (Somerville et al., 2017). Other options to support communal activities may include assistance from volunteers or family support groups. Thus, future enriched environment studies that explore variety in communal activities that are offered daily to support alignment with preclinical models are recommended.

A further important difference to highlight between this study and preclinical animal studies is the absence of the physical exercise component. In preclinical studies the enriched environment includes physically demanding activity for rodents. Animal models of enrichment use larger cages, ladders, tunnels, and other toys to provide a range of different physical experiences, and on top offer 'physical exercise' such as access to running wheels, beams and intense reach training, which are also available 24-hours a day. In this study stroke patients did not have access to demanding physical exercises (e.g. seated bike, walking activities, stair climbing). This difference is important to emphasise, as in preclinical models the effect of enrichment on functional outcomes was greater

when physical exercise was included in the enriched environment model (Clarke et al., 2014). Indeed, the greatest effect of an enriched environment in preclinical models was achieved when physical exercise was offered in combination with an environment that stimulated physical, social and cognitive activity. At present, delivery of physical exercise is low in acute settings. Active upper limb therapy has been reported to include <5 minutes per day in the acute setting (Hayward & Brauer, 2015), while mean time spent walking was reported as 31 minutes in the subacute setting (Fini et al., 2017). Walking time in the acute setting is likely even lower as more patients are dependent and a smaller proportion of stroke survivors are able to walk. Activities in line with preclinical models where physical exercise is an important element of environmental enrichment would include development of safe physical exercise activities that can be used by patients. This suggests that future enrichment models need to investigate the effect of access to physical exercise within enriched environment models in the clinical setting while considering brain repair processes early after stroke (Ward, 2017) and the balance with rest (Pincherle et al., 2017).

8.5.1.2 Resources and self-directed activities

The enriched environment we implemented in this thesis provided a novel and complex environment that has the potential to stimulate the stroke survivor in all activity domains. Staff interviews showed that it was challenging in certain stroke survivors to offer sufficient stimulation. Within the enriched acute stroke unit environment we had access to limited resources and self-directed activities such as music, GRASP and therapy apps on the iPad. Development of stimulating activities that are meaningful for stroke survivors and that can be utilised independently may strengthen the enriched environment. There is a need for these activities to be accessible to stroke survivors outside of therapy hours (Luker et al., 2015). Self-directed upper limb, mobility activities, and smart use of technology such as gaming, virtual reality and robotics may enhance environmental enrichment in an acute stroke unit. Limitations of technology include the need for training and cognitive engagement of the patient, which may be limited in the early phase after stroke. Thus, activities that can be initiated in the acute stroke unit and that the stroke survivor can perform across the continuum of care may support and promote self-management of activities in the long term. In addition, equipment that is affordable, that targets specific impairments or activity limitations (such as language or upper limb impairments) and include different levels of difficulties may fill this gap.

8.5.1.3 Expectations, perceptions and experiences

To determine which type of activities are needed in the acute stroke unit setting it is critical that we investigate how stroke survivors and their families engage in activities. A systematic review has shown that stroke survivors in acute and subacute inpatient rehabilitation highly valued physical activity and wanted more opportunities to engage in meaningful practice and recreational activities (Luker et al., 2015). An enriched environment may be one approach to support stroke survivors in increased opportunities for meaningful activities. A scoping review that investigated boredom showed that stroke survivors commonly experienced to be bored in acute and subacute inpatient settings and stroke survivors emphasised that communal areas and outdoor spaces where stroke survivors can engage in activities would reduce boredom (Kenah et al., 2017). At present, it is unknown how patients and carers' experienced and perceived the enriched environment in the acute stroke unit where these activities and opportunities were offered to the stroke survivors to some extent. This highlights the need to more deeply explore stroke survivors and carers expectations, perceptions and experiences regarding personal and communal enrichment including communal mealtimes and group activities. In addition, questioning how the intervention can be tailored to each individual, and if the offered enrichment in the acute stroke unit is perceived as meaningful may refine the enriched environment in the acute stroke unit. Exploring patients and carers perspective may also provide information regarding individual differences, the need for time to cope with loss and grief, and how balance between rest and activity can be achieved (Eng et al., 2014). Taken together, future studies that investigate how patients and carers perceive and experience an enriched environment in an acute stroke unit, and how enrichment can be tailored to each individual, the need for time to deal with loss and grief and allow rest is recommended.

8.5.2 Understanding the effect of an enriched environment

8.5.2.1 Understanding neurobiology

A future direction includes development of studies that explore to understand how the enriched environment may impact on neurobiology and individual differences post stroke. As highlighted in the Stroke Rehabilitation and Recovery Roundtable (SRRR) there is an urgent need for studies exploring biological mechanism in humans post stroke (Bernhardt et al., 2017). Preclinical enrichment studies have highlighted biological mechanisms in rodent models that can guide future

human studies. Preclinical (animal) studies found e.g. a time window during the first 4-weeks after stroke for heightened plasticity after focal brain injury (Biernaskie et al., 2004), and have shown that a large degree and rate of recovery are strongly predictable and relate to spontaneous recovery in rodents (Jeffers et al., 2018). Clinical research may not gain the detailed understanding in mechanism that support brain repair and recovery as found in rodent models, but clinical enriched environment research can develop studies that investigate biomarkers and the underpinning biological mechanism. Studies using functional Magnetic Resonance Imaging (MRI), or electroencephalogram (EEG) to understand how the enriched environment may impact on brain perfusion, cortical and subcortical networks, as well as using diffusion weighted imaging to investigate structural changes for example white matter fibre integrity may benefit understanding the effects of an enriched environment (Corbett et al., 2017). Furthermore, exploring blood biomarkers (e.g. neurotrophic factors or inflammatory markers) or psychological stress markers (e.g. cortisol levels) are other directions of future research to understand who may profit from an enriched environment, and what are the underlying biological mechanisms of recovery affected by an enriched environment in human stroke populations (Corbett et al., 2017; Ward, 2017). Conversely, preclinical research should attempt to mirror the clinical setting more closely. The majority of animal studies used young adult male rodents (Simpson & Kelly, 2011) while within the clinical settings stroke patients' characteristics include on average an older age, and variety in stroke features, premorbid medical conditions and prior living situations. Collaboration between clinical and preclinical researchers to inform and feed into future translation of an enriched environment is needed (Ward, 2017).

8.5.2.2 Characteristics of an enriched environment

In order to support studies that explore the potential neurobiological mechanism of an enriched environment, we also need to investigate characteristics of an enriched environment such as optimal timing, dose of environmental enrichment and the amount of time a patient needs to be exposed to an enriched environment to enable recovery. This thesis showed no differences in functional measures between the control and intervention group. We indicated that the selection of outcome measures and/or the small sample size may have impacted on the inability to detect functional differences between groups. However, other plausible explanations may entail that timing of the enriched environment was not optimal, or that stroke patients had insufficient engagement on a day-to-day basis to enrichment within the acute stroke unit (received a 'low dose of enrichment') or that patients' length of stay was to short resulting in low amount of time exposed to the enriched

environment. Recommendation from the SRRR on how dose of intervention should be reported include 1) how the intervention should be delivered, 2) by who, 3) how often, 4) how intense and 5) for how long (Walker et al., 2017).

The optimal timing of when to introduce an enriched environment in the human stroke population is unknown. We used evidence from preclinical models to start the enriched environment 24-hours post stroke as that timing increased functional recovery in rodents, while lesser effects were shown when the initiation of the enriched environment was delayed until 5-days post stroke (Biernaskie et al., 2004; Johansson, 2004). In addition, increased infarct size has been shown in some studies when an enriched environment was initiated earlier than 24-hours post stroke (Risedal et al., 1999). AVERT showed that too early (within 24 hours) and too much intense therapy (in the first 14-days post stroke) in acute stroke patients resulted in a higher mRS score at three months post stroke (AVERT Trial Collaboration group, 2015). Furthermore, to support physiological processes early after stroke intense therapy within the first 72-hours post stroke in humans should be avoided (Krakauer et al., 2012). These results need to be considered, but a direct comparison cannot be made, as the effect of an enriched environment that stimulates social and cognitive activity in addition to physical may not be the same as rehabilitation therapy that might focus on function. Engagement in the enriched environment study showed significantly fewer adverse events and no difference in the frequency of serious adverse events, which implies that the timing of the enriched environment in humans was safe, but we are unable to answer if this timing leads to the optimal effect on outcomes.

Future studies that define ‘the dose’ of enrichment may benefit descriptions of fidelity of the enriched environment intervention and result in understanding how much engagement is needed. To date, studies have not attempted to define ‘the dose’ of enrichment or described how much patients engaged in enrichment activities. In the majority of preclinical and clinical enrichment studies the enriched environment is available 24-hours a day, but until now it is unknown how much or how often rodents or stroke survivors engaged with offered stimulation. Dose of enrichment can be further described as the frequency, intensity and/or time rodents or stroke survivors are engaged in enrichment activities. A possible study design to help understand dose characteristics of an enriched environment is by using a novel 3x3 design, a method more commonly used in pharmaceutical trials and not yet frequently used in rehabilitation (Dite et al., 2015). Progressively increasing the ‘intensity’ of exposure to physical, social and cognitive enrichment may shape the intervention package that is required to achieve functional recovery. In a 3x3 design 3(5) stroke patients are exposed to a certain dose of enrichment and effects are measured. The dose is incremental increased to determine effects on outcomes. If a stroke survivor experiences a negative effect, 3(5) more

stroke patients are included at that dose level to determine if similar negative effects are measured (Dite et al., 2015). Such a model may allow to demonstrate how the dose impacts on function, activity levels, wellbeing and fatigue levels after stroke and when maximum levels are reached, but the potential heterogeneity of the stroke population and their varied engagement in and response to enrichment is a complication that needs to be simultaneously addressed.

The amount of time a patient needs to be exposed to the enriched environment is a further characteristic that may need to be investigated. At present we are unable to answer the amount of time a patient needs to be exposed to an enriched environment, and what factors might impact this metric. It is possible that stroke patients need to be exposed for a certain period of time before an effect on functional recovery can be found. This suggests that stroke survivors who recovered in an enriched acute and subacute rehabilitation setting may have a higher likelihood to demonstrate functional recovery as compared to stroke survivors who were only exposed to the enriched environment in the acute setting. To date, enriched environment studies have investigated the enriched environment in an acute or subacute inpatient rehabilitation setting. Thus, studies exposing stroke survivors to an enriched acute and subacute inpatient rehabilitation environment are recommended. However, a large proportion of stroke survivors will directly go home after their acute stroke unit stay, which means that these stroke patients only have the ability to be exposed for a short period of time to an enriched environment. Evidence suggests that stroke survivors who return home are less involved in activities in the community and are more sedentary than their healthy counterparts (Paul et al., 2016). Exploring if a complex and challenging enriched environment can be translated to the home environment is a future opportunity for studies to explore. In our thesis we included education and information provision to stroke survivors to enhance awareness of the benefits of activity after stroke. This also highlights that the acute stroke unit has a crucial role in educating stroke patients who go home after their acute stay. The concept of an enriched home environment that advocates self-management and self-directed therapeutic activities within the home may also contribute to increasing the total time of exposure of enrichment and needs to be explored in the future. Taken together, the characteristics 1) optimal timing 2) dose of day to day engagement, and 3) amount of time exposed to an enrichment environment needs to be further explored in future studies.

8.5.2.3 Effect on depression, anxiety, stress and quality of life

Khan et al. 2016 showed that stroke survivors had significant reduced depression and anxiety scores at discharge from the enriched environment in the subacute inpatient rehabilitation setting. This thesis showed no differences between groups for depression and anxiety. Reduced time being alone, increased opportunities to be active, reduced boredom and more social support may impact on general well being in an enriched environment. Stroke survivors have indicated in previous qualitative work to experience high amounts of boredom in hospital inpatient settings, and that boredom adversely impacted on mood and motivation in stroke survivors (Kenah et al., 2017; Luker et al., 2015). In addition, boredom has shown to be highly correlated to depression (Goldberg et al., 2011). Lack of control is another factor that has been expressed by stroke survivors to increase levels of frustration and stress and reduce wellbeing (Luker et al., 2015). Disempowering staff attitudes that restricted stroke survivors in their independence and choices have been shown to strongly contribute to feelings of a lack of control and dependency (Luker et al., 2015). Furthermore, reducing the opportunity for stroke survivors to drive their own recovery may facilitate long-term reliance and dependency on external agents for recovery (Eng et al., 2014). An enriched environment is an intervention that may reduce boredom and empower stroke survivors and families in independent activity outside therapy. Future exploration how an enriched environment impacts on depression, anxiety, boredom, stress, fatigue and quality of life are important to understand and future studies are recommended.

8.5.3 Impact of the physical build design of the unit

Qualitative interviews with staff in this thesis showed that the physical design of the unit impacted on the enriched environment. The physical design of the acute stroke unit in this study included a therapy room in close proximity of the bedrooms to support communal activities. Furthermore, the acute stroke unit build design included single patient and two patient bedrooms, and we transformed public space into three small seating areas. Staff expressed that they found it challenging to set up tables for communal mealtimes daily in the therapy room. They advised that design of the unit with access to communal areas and green spaces may enhance the enriched environment intervention. This raises an important question of how the physical build design may facilitate optimal delivery of stroke care. Stroke clinical guidelines recommend an early start to rehabilitation after stroke, which indicates that the physical design of stroke units need to support optimal delivery of stroke

care and promote early rehabilitation (Anaker et al., 2018). In rodent models of enrichment, the built environment can be easily changed regularly and at minimal cost. However, changes to the built environment in hospital are costly endeavours that may negatively impact how a patient engages with the environment for long into the future. For example, recent findings that tracked patients in a rehabilitation environment pre and post rebuilding the environment highlighted how location of the communal space (e.g., in a far corner of the unit with a small entrance vs. end of a corridor with a noticeable entrance), and bed lay out (single vs. multi-room) influenced activity levels of patients, and their ability to optimally engage with the environment. Findings indicated that in the new build environment patients spent more time in their rooms, were less active, and had fewer interactions with staff and family than patients in the original unit (Anaker et al., 2017). Until now, only a few studies have investigated how patient activities relate to lay out of the physical design of the unit and have highlighted that physical design may impact on patients' activity levels (Anaker et al., 2017; Blennerhassett et al., 2018; Shannon et al., 2018). While there is a push towards single bedrooms for reasons such as infection control, the possible impact on stroke recovery, activity levels and interaction with others needs to be seriously considered as well (Maben et al., 2016; Pennington & Isles, 2013). An optimal physical environment is one that facilitates and supports recovery after stroke. The enriched environment in the acute stroke unit showed how communal activity had a large effect on increasing patients' activity levels, and that presence of a therapy room in close proximity to bedrooms enabled group activities. It appears that embedding an enriched environment may be enhanced when the physical environment would include a variety of communal areas, access to therapy and green spaces. In contrast, an acute stroke unit without these physical features may limit embedding an enriched environment. Design features such as visibility to enhance safety, easy navigation to find communal areas, ability for stroke survivors to access therapy space independently (e.g. therapy room to far away or automatic locked doors) need to support optimal physical build design. Future studies that investigate the impact of the physical build design on the enriched environment intervention needs to be further explored.

8.5.4 Future enriched environment studies

To design a future efficacy trial and to specify the intervention it is important to question if the embedded enriched environment intervention in the acute stroke unit is generalizable to other acute stroke units. Factors such as the willingness of staff to change practice, need for change management, physical build design of the stroke unit, and leadership have been shown to be important elements that may impact on an enriched environment. Other factors that needs

consideration before moving towards a large efficacy trial is the available evidence. Previous trials of interventions in hospitals have shown positive effects in small and moderate size studies and no effect in large phase III trials (AVERT Trial Collaboration group, 2015; Barker et al., 2016). The impact of daily competing requirements and priorities may interfere in trials that are running over a long time period. At present a phase II Altering the Rehabilitation Environment to Improve Stroke Survivor Activity (AREISSA) study is being conducted in the subacute inpatient rehabilitation and is registered with the Australian New Zealand Clinical Trial Registry. This study may provide further evidence to guide future trials and implementation of an enriched environment.

There is also a danger in publishing early phase I and II study results, as clinicians start to implement single elements of the published interventions in clinical practice. A slow shift in clinical practice was demonstrated in the large efficacy trial AVERT, where clinicians mobilised stroke patients every year earlier who were randomised to usual care. The most likely explanation of this effect was that clinicians believed that earlier mobilisation was more beneficial as was suggested by the phase II study results published in 2011 (Cumming et al., 2011). The shift in clinical practice reduced the difference in the two applied interventions and led to the inability to detect a difference between standard care and intervention arm. Therefore, widespread of an enriched environment should not be promoted at present: 1) as there is no strong evidence to support implementation, and 2) to avoid any shift in clinical practice that may affect standard care. The danger that clinicians may change practice suggests a large efficacy trial should not be delayed too long.

Finally, there is a need to consider how we best design a larger efficacy trial. The intervention is delivered at ward level, so a cluster design can support an intervention at ward level. To reduce the effect of confounders to result e.g. build design of the unit, team factors, delivered therapy etc. the previous discussed stepped wedge design may be a plausible choice. In a stepped wedge design every site will recruit a control and intervention group, receive an implementation package to embed the enriched environment, and monitor for intervention fidelity. Randomisation of the clusters will add to blinding and inclusion of assessors blinded to both group allocation and the study aims of the study will contribute to a robust design. However, further discussion and/or evidence is still needed to define outcome measures, dose, intervention package and need for stratification.

8.6 Conclusions

This thesis showed that embedding an enriched environment in an acute stroke unit with usual staffing levels can increase physical, social and cognitive activity levels in acute stroke survivors, with follow up observations showing that increased activity levels were sustained 6-months post implementation of the intervention. Stroke survivors who recovered in the enriched acute stroke unit environment experienced less adverse events indicating the intervention was safe to deliver. Further in-depth analysis of the observational data showed that scheduled communal activities and provision of stimulating resources in the unit and at the bedside were major contributors of the intervention to increase activity levels in stroke survivors. Qualitative staff exploration showed that staff perceived the enriched environment to positively contribute to the stroke survivors' recovery, and staff highlighted the critical role of teamwork and need for prolonged change management for successful implementation of the intervention in an acute stroke unit. This thesis has demonstrated that the enriched environment may act as an adjunctive intervention to increase activity levels in acute stroke survivors in the acute stroke unit. Future steps are to demonstrate the impact of an enriched environment on stroke survivors' functional outcomes, quality of life and disability. The original and new findings presented in this thesis will contribute to future clinical translation of an enriched environment into human populations post stroke. Combination of the positive findings demonstrated in the first translation of an enriched environment into the clinical acute setting post stroke, and the robust evidence shown in preclinical research makes the enriched environment a promising intervention that may result eventually in widespread clinical implementation.

List of references

Aben, I, Verhey, F, Lousberg, R, Lodder, J& Honig, A. (2002). Validity of the beck depression inventory, hospital anxiety and depression scale, SCL-90, and hamilton depression rating scale as screening instruments for depression in stroke patients. *Psychosomatics, 43*(5), 386-393. doi:10.1176/appi.psy.43.5.386

Ahmed, N, Kellert, L, Lees, KR, Mikulik, R, Tatlisumak, T& Toni, D. (2013). Results of intravenous thrombolysis within 4.5 to 6 hours and updated results within 3 to 4.5 hours of onset of acute ischemic stroke recorded in the Safe Implementation of Treatment in Stroke International Stroke Thrombolysis Register (SITS-ISTR): an observational study. *JAMA Neurol, 70*(7), 837-844. doi:10.1001/jamaneurol.2013.406

Anaker, A, von Koch, L, Sjostrand, C, Bernhardt, J& Elf, M. (2017). A comparative study of patients' activities and interactions in a stroke unit before and after reconstruction-The significance of the built environment. *PLoS One, 12*(7), e0177477. doi:10.1371/journal.pone.0177477

Anaker, A, von Koch, L, Sjostrand, C, Heylighen, A& Elf, M. (2018). The physical environment and patients' activities and care: A comparative case study at three newly built stroke units. *J Adv Nurs*. doi:10.1111/jan.13690

Andrew, NE, Kilkenny, M, Naylor, R, Purvis, T, Lalor, E, Moloczij, N& Cadilhac, DA. (2014). Understanding long-term unmet needs in Australian survivors of stroke. *Int J Stroke, 9 Suppl A100*, 106-112. doi:10.1111/ijs.12325

Askim, T, Bernhardt, J, Loge, AD& Indredavik, B. (2012). Stroke patients do not need to be inactive in the first two-weeks after stroke: results from a stroke unit focused on early rehabilitation. *Int J Stroke, 7*(1), 25-31. doi:10.1111/j.1747-4949.2011.00697.x

Australian Bureau of Statistics. (2017). *Australian Demographics Statistics*. Canberra.

Australian Commission on Safety and Quality in Health Care. (2010). *Patient-centred care: improving quality and safety by focusing care on patients and consumers*. Sydney, Australia.

Australian Institute of Health and Welfare. (2013). *Stroke and its management in Australia: an update*. http://www.aihw.gov.au: Cardiovascular disease series 37. Cat. no. CVD 61.

Australian Institute of Health and Welfare. (2016). *Australia's health 2016*. Canberra.

AVERT Trial Collaboration group. (2015). Efficacy and safety of very early mobilisation within 24 h of stroke onset (AVERT): a randomised controlled trial. *Lancet*. doi:10.1016/s0140-6736(15)60690-0

Balami, JS, Sutherland, BA, Edmunds, LD, Grunwald, IQ, Neuhaus, AA, Hadley, G, . . . Buchan, AM. (2015). A systematic review and meta-analysis of randomized controlled trials of endovascular thrombectomy compared with best medical treatment for acute ischemic stroke. *Int J Stroke, 10*(8), 1168-1178. doi:10.1111/ijs.12618

Bamford, J, Sandercock, P, Dennis, M, Burn, J& Warlow, C. (1991). Classification and natural history of clinically identifiable subtypes of cerebral infarction. *Lancet, 337*(8756), 1521-1526.

Banks, JL& Marotta, CA. (2007). Outcomes validity and reliability of the modified Rankin scale: implications for stroke clinical trials: a literature review and synthesis. *Stroke, 38*(3), 1091-1096. doi:10.1161/01.STR.0000258355.23810.c6

Barker, AL, Morello, RT, Wolfe, R, Brand, CA, Haines, TP, Hill, KD, . . . Kamar, J. (2016). 6-PACK programme to decrease fall injuries in acute hospitals: cluster randomised controlled trial. *Bmj, 352*, h6781. doi:10.1136/bmj.h6781

Barr, J, McKinley, S, O'Brien, E& Herkes, G. (2006). Patient recognition of and response to symptoms of TIA or stroke. *Neuroepidemiology, 26*(3), 168-175. doi:10.1159/000091659

Baumann, M, Peck, S, Collins, C& Eades, G. (2013). The meaning and value of taking part in a person-centred arts programme to hospital-based stroke patients: findings from a qualitative study. *Disabil Rehabil, 35*(3), 244-256. doi:10.3109/09638288.2012.694574

Baylan, S, McGinlay, M, MacDonald, M, Easto, J, Cullen, B, Haig, C, . . . Evans, JJ. (2018). Participants' experiences of music, mindful music, and audiobook listening interventions for people recovering from stroke. *Ann N Y Acad Sci*. doi:10.1111/nyas.13618

Bernhardt, J, Borschmann, K, Boyd, L, Thomas Carmichael, S, Corbett, D, Cramer, SC, . . . Ward, N. (2016a). Moving rehabilitation research forward: Developing consensus statements for rehabilitation and recovery research. *Int J Stroke, 11*(4), 454-458. doi:10.1177/1747493016643851

Bernhardt, J, Chan, J, Nicola, I& Collier, JM. (2007). Little therapy, little physical activity: rehabilitation within the first 14 days of organized stroke unit care. *J Rehabil Med, 39*(1), 43-48. doi:10.2340/16501977-0013

Bernhardt, J, Churilov, L, Ellery, F, Collier, J, Chamberlain, J, Langhorne, P, . . . Donnan, G. (2016b). Prespecified dose-response analysis for A Very Early Rehabilitation Trial (AVERT). *Neurology, 86*(23), 2138-2145. doi:10.1212/wnl.0000000000002459

Bernhardt, J, Dewey, H, Thrift, A& Donnan, G. (2004). Inactive and alone: physical activity within the first 14 days of acute stroke unit care. *Stroke, 35*(4), 1005-1009. doi:10.1161/01.str.0000120727.40792.40

Bernhardt, J, Hayward, KS, Kwakkel, G, Ward, NS, Wolf, SL, Borschmann, K, . . . Cramer, SC. (2017). Agreed Definitions and a Shared Vision for New Standards in Stroke Recovery Research: The Stroke Recovery and Rehabilitation Roundtable Taskforce. *Neurorehabil Neural Repair, 31*(9), 793-799. doi:10.1177/1545968317732668

Biernaskie, J, Chernenko, G& Corbett, D. (2004). Efficacy of rehabilitative experience declines with time after focal ischemic brain injury. *J Neurosci, 24*(5), 1245-1254. doi:10.1523/jneurosci.3834-03.2004

Biernaskie, J& Corbett, D. (2001). Enriched rehabilitative training promotes improved forelimb motor function and enhanced dendritic growth after focal ischemic injury. *J Neurosci, 21*(14), 5272-5280.

Bjelland, I, Dahl, AA, Haug, TT& Neckelmann, D. (2002). The validity of the Hospital Anxiety and Depression Scale. An updated literature review. *J Psychosom Res, 52*(2), 69-77.

Blennerhassett, JM, Borschmann, KN, Lipson-Smith, RA& Bernhardt, J. (2018). Behavioral Mapping of Patient Activity to Explore the Built Environment During Rehabilitation. *Herd*, 1937586718758444. doi:10.1177/1937586718758444

Bower, KJ, Clark, RA, McGinley, JL, Martin, CL& Miller, KJ. (2014). Clinical feasibility of the Nintendo Wii for balance training post-stroke: a phase II randomized controlled trial in an inpatient setting. *Clin Rehabil, 28*(9), 912-923. doi:10.1177/0269215514527597

Brady, M, Stott, D, Norrie, J, Chalmers, C, St George, B, Sweeney, P& Langhorne, P. (2011). Developing and evaluating the implementation of a complex intervention: Using mixed methods to inform the design of a randomised controlled trial of an oral healthcare intervention after stroke. *Trials, 12*. doi:10.1186/1745-6215-12-168

Brady, MC, Kelly, H, Godwin, J, Enderby, P& Campbell, P. (2016). Speech and language therapy for aphasia following stroke. *Cochrane Database Syst Rev*(6), Cd000425. doi:10.1002/14651858.CD000425.pub4

Braun, V& Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology, 3*(2), 77-101. doi:10.1191/1478088706qp063oa

Breitenstein, C, Grewe, T, Flöel, A, Ziegler, W, Springer, L, Martus, P, . . . Bamborschke, S. (2017). Intensive speech and language therapy in patients with chronic aphasia after stroke: a randomised, open-label, blinded-endpoint, controlled trial in a health-care setting. *The Lancet, 389*(10078), 1528-1538. doi:10.1016/S0140-6736(17)30067-3

Briggs, DE, Felberg, RA, Malkoff, MD, Bratina, P& Grotta, JC. (2001). Should mild or moderate stroke patients be admitted to an intensive care unit? *Stroke, 32*(4), 871-876.

Brooks, W. (2004). The use of practice guidelines for urinary incontinence following stroke. *Br J Nurs, 13*(20), 1176-1179. doi:10.12968/bjon.2004.13.20.17006

Buchhold, B, Mogoanta, L, Suofu, Y, Hamm, A, Walker, L, Kessler, C& Popa-Wagner, A. (2007). Environmental enrichment improves functional and neuropathological indices following stroke in young and aged rats. *Restor Neurol Neurosci, 25*(5-6), 467-484.

Campbell, BCV, Mitchell, PJ, Churilov, L, Keshtkaran, M, Hong, K-S, Kleinig, TJ, . . . on behalf of the, E-IAIMACJJYJMJVFSWRVAE. (2017). Endovascular Thrombectomy for Ischemic Stroke Increases Disability-Free Survival, Quality of Life, and Life Expectancy and Reduces Cost. *Frontiers in Neurology, 8*, 657. doi:10.3389/fneur.2017.00657

Campbell Burton, CA, Murray, J, Holmes, J, Astin, F, Greenwood, D& Knapp, P. (2013). Frequency of anxiety after stroke: a systematic review and meta-analysis of observational studies. *Int J Stroke, 8*(7), 545-559. doi:10.1111/j.1747-4949.2012.00906.x

Canadian Heart & Stroke Foundation. (2013). *Canadian Stroke Best Practice Recommendation*.

Caruana, EL, Kuys, SS, Clarke, J& Bauer, SG. (2017). A pragmatic implementation of a 6-day physiotherapy service in a mixed inpatient rehabilitation unit. *Disabil Rehabil, 39*(17), 1738-1743. doi:10.1080/09638288.2016.1211181

Casaubon, B, on behalf of the Acute Inpatient Stroke Care Writing Group,. (2015). *Acute Inpatient Stroke Care Module 2015*.

Cattanach, N, Sheedy, R, Gill, S& Hughes, A. (2014). Physical activity levels and patients' expectations of physical activity during acute general medical admission. *Intern Med J, 44*(5), 501-504. doi:10.1111/imj.12411

Chen, JY, Yu, Y, Yuan, Y, Zhang, YJ, Fan, XP, Yuan, SY, . . . Yao, SL. (2017). Enriched housing promotes post-stroke functional recovery through astrocytic HMGB1-IL-6-mediated angiogenesis. *Cell Death Discov, 3*, 17054. doi:10.1038/cddiscovery.2017.54

Chun, HY, Whiteley, WN, Dennis, MS, Mead, GE& Carson, AJ. (2018). Anxiety After Stroke: The Importance of Subtyping. *Stroke, 49*(3), 556-564. doi:10.1161/strokeaha.117.020078

Clarke, DJ& Forster, A. (2015). Improving post-stroke recovery: the role of the multidisciplinary health care team. *J Multidiscip Healthc, 8*, 433-442. doi:10.2147/jmdh.s68764

Clarke, J, Langdon, KD& Corbett, D. (2014). Early poststroke experience differentially alters periinfarct layer II and III cortex. *J Cereb Blood Flow Metab, 34*(4), 630-637. doi:10.1038/jcbfm.2013.237

Clemenson, GD, Deng, W& Gage, FH. (2015). Environmental enrichment and neurogenesis: from mice to humans. *Current Opinion in Behavioral Sciences, 4*, 56-62. doi:http://dx.doi.org/10.1016/j.cobeha.2015.02.005

Collen, FM, Wade, DT& Bradshaw, CM. (1990). Mobility after stroke: reliability of measures of impairment and disability. *Int Disabil Stud, 12*(1), 6-9.

Corbett, D, Carmichael, ST, Murphy, TH, Jones, TA, Schwab, ME, Jolkkonen, J, . . . Joy, MT. (2017). Enhancing the Alignment of the Preclinical and Clinical Stroke Recovery Research Pipeline: Consensus-Based Core Recommendations From the Stroke Recovery and Rehabilitation Roundtable Translational Working Group. *Neurorehabil Neural Repair, 31*(8), 699-707. doi:10.1177/1545968317724285

Corbett, D, Nguemeni, C& Gomez-Smith, M. (2014). How can you mend a broken brain? Neurorestorative approaches to stroke recovery. *Cerebrovasc Dis, 38*(4), 233-239. doi:10.1159/000368887

Cumming, TB, Thrift, AG, Collier, JM, Churilov, L, Dewey, HM, Donnan, GA& Bernhardt, J. (2011). Very early mobilization after stroke fast-tracks return to walking: further results from the phase II AVERT randomized controlled trial. *Stroke, 42*(1), 153-158. doi:10.1161/strokeaha.110.594598

De Weerdt, W, Nuyens, G, Feys, H, Vangronsveld, P, Van de Winckel, A, Nieuwboer, A, . . . Kiekens, C. (2001). Group physiotherapy improves time use by patients with stroke in rehabilitation. *Aust J Physiother, 47*(1), 53-61.

Deloitte Access Economics. (2013). *The economic impact of stroke in Australia*.

Des Roches, CA, Balachandran, I, Ascenso, EM, Tripodis, Y& Kiran, S. (2014). Effectiveness of an impairment-based individualized rehabilitation program using an iPad-based software platform. *Front Hum Neurosci, 8*, 1015. doi:10.3389/fnhum.2014.01015

Devlin, AS& Arneill, AB. (2003). Health Care Environments and Patient Outcomes: A Review of the Literature. *Environment and Behavior, 35*(5), 665-694. doi:10.1177/0013916503255102

Diserens, K, Moreira, T, Hirt, L, Faouzi, M, Grujic, J, Bieler, G, . . . Michel, P. (2012). Early mobilization out of bed after ischaemic stroke reduces severe complications but not cerebral blood flow: a randomized controlled pilot trial. *Clin Rehabil, 26*(5), 451-459. doi:10.1177/0269215511425541

Dite, W, Langford, ZN, Cumming, TB, Churilov, L, Blennerhassett, JM& Bernhardt, J. (2015). A Phase 1 exercise dose escalation study for stroke survivors with impaired walking. *Int J Stroke, 10*(7), 1051-1056. doi:10.1111/ijs.12548

Drury, P, Levi, C, D'Este, C, McElduff, P, McInnes, E, Hardy, J, . . . Middleton, S. (2014). Quality in Acute Stroke Care (QASC): process evaluation of an intervention to improve the management of fever, hyperglycemia, and swallowing dysfunction following acute stroke. *Int J Stroke, 9*(6), 766-776. doi:10.1111/ijs.12202

Eames, S, Hoffmann, T, Worrall, L& Read, S. (2010). Stroke patients' and carers' perception of barriers to accessing stroke information. *Top Stroke Rehabil, 17*(2), 69-78. doi:10.1310/tsr1702-69

Emberson, J, Lees, KR, Lyden, P, Blackwell, L, Albers, G, Bluhmki, E, . . . Hacke, W. (2014). Effect of treatment delay, age, and stroke severity on the effects of intravenous thrombolysis with alteplase for acute ischaemic stroke: a meta-analysis of individual patient data from randomised trials. *Lancet, 384*(9958), 1929-1935. doi:10.1016/s0140-6736(14)60584-5

Eng, JJ. (2010). Fitness and Mobility Exercise (FAME) Program for stroke. *Topics in geriatric rehabilitation, 26*(4), 310-323. doi:10.1097/TGR.0b013e3181fee736

Eng, XW, Brauer, SG, Kuys, SS, Lord, M& Hayward, KS. (2014). Factors Affecting the Ability of the Stroke Survivor to Drive Their Own Recovery outside of Therapy during Inpatient Stroke Rehabilitation. *Stroke Res Treat, 2014*, 8. doi:10.1155/2014/626538

English, C, Hillier, S, Kaur, G& Hundertmark, L. (2014). People with stroke spend more time in active task practice, but similar time in walking practice, when physiotherapy rehabilitation is provided in circuit classes compared to individual therapy sessions: an observational study. *J Physiother, 60*(1), 50-54. doi:10.1016/j.jphys.2013.12.006

English, C, Hillier, SL& Lynch, EA. (2017). Circuit class therapy for improving mobility after stroke. *Cochrane Database Syst Rev, 6*, Cd007513. doi:10.1002/14651858.CD007513.pub3

EuroQol group. (1990). EuroQol--a new facility for the measurement of health-related quality of life. *Health Policy, 16*(3), 199-208.

Feigin, VL, Krishnamurthi, RV, Parmar, P, Norrving, B, Mensah, GA, Bennett, DA, . . . Roth, GA. (2015a). Update on the Global Burden of Ischemic and Hemorrhagic Stroke in 1990-2013: The GBD 2013 Study. *Neuroepidemiology, 45*(3), 161-176. doi:10.1159/000441085

Feigin, VL, Mensah, GA, Norrving, B, Murray, CJ& Roth, GA. (2015b). Atlas of the Global Burden of Stroke (1990-2013): The GBD 2013 Study. *Neuroepidemiology, 45*(3), 230-236. doi:10.1159/000441106

Fini, NA, Holland, AE, Keating, J, Simek, J& Bernhardt, J. (2017). How Physically Active Are People Following Stroke? Systematic Review and Quantitative Synthesis. *Phys Ther, 97*(7), 707-717. doi:10.1093/ptj/pzx038

Fryer, CE, Luker, JA, McDonnell, MN& Hillier, SL. (2016). Self management programmes for quality of life in people with stroke. *Cochrane Database Syst Rev*(8), Cd010442. doi:10.1002/14651858.CD010442.pub2

Galvin, R, Cusack, T, O'Grady, E, Murphy, TB& Stokes, E. (2011). Family-mediated exercise intervention (FAME): evaluation of a novel form of exercise delivery after stroke. *Stroke, 42*(3), 681-686. doi:10.1161/strokeaha.110.594689

Galvin, R, Cusack, T& Stokes, E. (2008). A randomised controlled trial evaluating family mediated exercise (FAME) therapy following stroke. *BMC Neurol, 8*, 22. doi:10.1186/1471-2377-8-22

Galvin, R, Cusack, T& Stokes, E. (2009). To what extent are family members and friends involved in physiotherapy and the delivery of exercises to people with stroke? *Disabil Rehabil, 31*(11), 898-905. doi:10.1080/09638280802356369

Galvin, R, Stokes, E& Cusack, T. (2014). Family-Mediated Exercises (FAME): an exploration of participant's involvement in a novel form of exercise delivery after stroke. *Top Stroke Rehabil, 21*(1), 63-74. doi:10.1310/tsr2101-63

Gentile, AM, Beheshti, Z& Held, JM. (1987). Enrichment versus exercise effects on motor impairments following cortical removals in rats. *Behav Neural Biol, 47*(3), 321-332.

Giroud, M, Jacquin, A& Bejot, Y. (2014). The worldwide landscape of stroke in the 21st century. *Lancet, 383*(9913), 195-197.

Glass, TA, Matchar, DB, Belyea, M& Feussner, JR. (1993). Impact of social support on outcome in first stroke. *Stroke, 24*(1), 64-70.

Gobbo, OL& O'Mara, SM. (2004). Impact of enriched-environment housing on brain-derived neurotrophic factor and on cognitive performance after a transient global ischemia. *Behavioural Brain Research, 152*(2), 231-241. doi:https://doi.org/10.1016/j.bbr.2003.10.017

Godecke, E, Armstrong, EA, Rai, T, Middleton, S, Ciccone, N, Whitworth, A, . . . Bernhardt, J. (2016). A randomized controlled trial of very early rehabilitation in speech after stroke. *Int J Stroke, 11*(5), 586-592. doi:10.1177/1747493016641116

Goldberg, YK, Eastwood, JD, LaGuardia, J& Danckert, J. (2011). Boredom: An Emotional Experience Distinct from Apathy, Anhedonia, or Depression. *Journal of Social and Clinical Psychology, 30*(6), 647-666. doi:10.1521/jscp.2011.30.6.647

Goldfarb, N. (2012). Adverse Event Terminology. *Journal of Clinical Research Best Practices, 8*(7).

Goldstein, LB& Samsa, GP. (1997). Reliability of the National Institutes of Health Stroke Scale. Extension to non-neurologists in the context of a clinical trial. *Stroke, 28*(2), 307-310.

Govan, L, Langhorne, P& Weir, CJ. (2007). Does the prevention of complications explain the survival benefit of organized inpatient (stroke unit) care?: further analysis of a systematic review. *Stroke, 38*(9), 2536-2540. doi:10.1161/strokeaha.106.478842

Government of Western Australia. (2015). Supporting and developing the allied health assistant workforce. Department of Health.

Goyal, M, Menon, BK, van Zwam, WH, Dippel, DW, Mitchell, PJ, Demchuk, AM, . . . Jovin, TG. (2016). Endovascular thrombectomy after large-vessel ischaemic stroke: a meta-analysis of individual patient data from five randomised trials. *Lancet, 387*(10029), 1723-1731. doi:10.1016/s0140-6736(16)00163-x

Grimley, R. (2016). Timing of Initial Mobilisation after Acute Stroke Relation to 180 day Outcomes. Asia Pacific Stroke Conference 2016. Abstracts of the Annual Conference of theAsia Pacific Stroke Organization (APSO) Combined with Stroke Society of Australasia. *Cerebrovascular Diseases, 42(suppl 1)*(Suppl. 1), 1-157.

Grol, R& Grimshaw, J. (2003). From best evidence to best practice: effective implementation of change in patients' care. *Lancet, 362*(9391), 1225-1230. doi:10.1016/s0140-6736(03)14546-1

Grossoehme, DH. (2014). Overview of qualitative research. *J Health Care Chaplain, 20*(3), 109-122. doi:10.1080/08854726.2014.925660

Hagedorn, H, Hogan, M, Smith, JL, Bowman, C, Curran, GM, Espadas, D, . . . Sales, AE. (2006). Lessons learned about implementing research evidence into clinical practice. Experiences from VA QUERI. *J Gen Intern Med, 21 Suppl 2*, S21-24. doi:10.1111/j.1525-1497.2006.00358.x

Hannan, AJ. (2014). Environmental enrichment and brain repair: harnessing the therapeutic effects of cognitive stimulation and physical activity to enhance experience-dependent plasticity. *Neuropathol Appl Neurobiol, 40*(1), 13-25. doi:10.1111/nan.12102

Harris, JE, Eng, JJ, Miller, WC& Dawson, AS. (2009). A self-administered Graded Repetitive Arm Supplementary Program (GRASP) improves arm function during inpatient stroke rehabilitation: a multi-site randomized controlled trial. *Stroke, 40*(6), 2123-2128. doi:10.1161/strokeaha.108.544585

Harris, JE, Eng, JJ, Miller, WC& Dawson, AS. (2010). The role of caregiver involvement in upper-limb treatment in individuals with subacute stroke. *Phys Ther, 90*(9), 1302-1310. doi:10.2522/ptj.20090349

Hayward, KS& Brauer, SG. (2015). Dose of arm activity training during acute and subacute rehabilitation post stroke: a systematic review of the literature. *Clin Rehabil, 29*(12), 1234-1243. doi:10.1177/0269215514565395

Hayward, KS, Eng, JJ, Boyd, LA, Lakhani, B, Bernhardt, J& Lang, CE. (2015). Exploring the Role of Accelerometers in the Measurement of Real World Upper-Limb Use After Stroke. *Brain Impairment, 17*(1), 16-33. doi:10.1017/BrImp.2015.21

Heart and Stroke Foundation of Canada. (2016). Canadian Stroke Best practice Recommendations.

Heart and Stroke Foundation of Canada. (2017). *Stroke report 2017 Different Strokes, Recovery triumphs and challenges at any age*.

Hebb, D. (1949). *The Organization of Behavior: A neuropsychological Theory*. New York: John Wiley& Sons Inc.

Hemming, K, Haines, TP, Chilton, PJ, Girling, AJ& Lilford, RJ. (2015). The stepped wedge cluster randomised trial: rationale, design, analysis, and reporting. *Bmj, 350*, h391. doi:10.1136/bmj.h391

Higgins, M, McKevitt, C& Wolfe, CD. (2005). Reading to stroke unit patients: perceived impact and potential of an innovative arts based therapy. *Disabil Rehabil, 27*(22), 1391-1398. doi:10.1080/09638280500164727

Hilari, K, Needle, JJ& Harrison, KL. (2012). What are the important factors in health-related quality of life for people with aphasia? A systematic review. *Arch Phys Med Rehabil, 93*(1 Suppl), S86-95. doi:10.1016/j.apmr.2011.05.028

Hinz, A& Brahler, E. (2011). Normative values for the hospital anxiety and depression scale (HADS) in the general German population. *J Psychosom Res, 71*(2), 74-78. doi:10.1016/j.jpsychores.2011.01.005

Hokstad, A, Indredavik, B, Bernhardt, J, Ihle-Hansen, H, Salvesen, O, Seljeseth, YM, . . . Askim, T. (2015). Hospital differences in motor activity early after stroke: a comparison of 11 Norwegian stroke units. *J Stroke Cerebrovasc Dis, 24*(6), 1333-1340. doi:10.1016/j.jstrokecerebrovasdis.2015.02.009

Hsieh, CH, Putman, K, Nichols, D, McGinty, ME, DeJong, G, Smout, RJ& Horn, S. (2010). Physical and occupational therapy in inpatient stroke rehabilitation: the contribution of therapy extenders. *Am J Phys Med Rehabil, 89*(11), 887-898. doi:10.1097/PHM.0b013e3181f70fb1

Huisman, E, Morales, E, Van Hoof, J& Kort, H. (2012). Healing environment: A review of the impact of physical environmental factors on users. *Building and environment, 58*, 70-80.

Hunger, M, Sabariego, C, Stollenwerk, B, Cieza, A& Leidl, R. (2012). Validity, reliability and responsiveness of the EQ-5D in German stroke patients undergoing rehabilitation. *Qual Life Res, 21*(7), 1205-1216. doi:10.1007/s11136-011-0024-3

Ilott, I, Gerrish, K, Eltringham, SA, Taylor, C& Pownall, S. (2016). Exploring factors that influence the spread and sustainability of a dysphagia innovation: an instrumental case study. *BMC Health Services Research, 16*, 406. doi:10.1186/s12913-016-1653-6

Indredavik, B, Bakke, F, Slordahl, SA, Rokseth, R& Haheim, LL. (1999). Treatment in a combined acute and rehabilitation stroke unit: which aspects are most important? *Stroke, 30*(5), 917-923.

Indredavik, B, Slordahl, SA, Bakke, F, Rokseth, R& Haheim, LL. (1997). Stroke unit treatment. Long-term effects. *Stroke, 28*(10), 1861-1866.
Janssen, H, Ada, L, Bernhardt, J, McElduff, P, Pollack, M, Nilsson, M& Spratt, N. (2014a). Physical, cognitive and social activity levels of stroke patients undergoing rehabilitation within a mixed rehabilitation unit. *Clin Rehabil, 28*(1), 91-101. doi:10.1177/0269215512466252
Janssen, H, Ada, L, Bernhardt, J, McElduff, P, Pollack, M, Nilsson, M& Spratt, NJ. (2014b). An enriched environment increases activity in stroke patients undergoing rehabilitation in a mixed rehabilitation unit: a pilot non-randomized controlled trial. *Disabil Rehabil, 36*(3), 255-262. doi:10.3109/09638288.2013.788218
Janssen, H, Ada, L, Karayanidis, F, Drysdale, K, McElduff, P, Pollack, M, . . . Spratt, NJ. (2012). Translating the use of an enriched environment poststroke from bench to bedside: study design and protocol used to test the feasibility of environmental enrichment on stroke patients in rehabilitation. *Int J Stroke, 7*(6), 521-526. doi:10.1111/j.1747-4949.2011.00727.x
Janssen, H, Bernhardt, J, Collier, JM, Sena, ES, McElduff, P, Attia, J, . . . Spratt, NJ. (2010). An enriched environment improves sensorimotor function post-ischemic stroke. *Neurorehabil Neural Repair, 24*(9), 802-813. doi:10.1177/1545968310372092
Jeffers, MS& Corbett, D. (2018). Synergistic Effects of Enriched Environment and Task-Specific Reach Training on Poststroke Recovery of Motor Function. *Stroke*. doi:10.1161/strokeaha.118.020814
Jeffers, MS, Karthikeyan, S& Corbett, D. (2018). Does Stroke Rehabilitation Really Matter? Part A: Proportional Stroke Recovery in the Rat. *Neurorehabil Neural Repair, 32*(1), 3-6. doi:10.1177/1545968317751210
Jha, S, Dong, B& Sakata, K. (2011). Enriched environment treatment reverses depression-like behavior and restores reduced hippocampal neurogenesis and protein levels of brain-derived neurotrophic factor in mice lacking its expression through promoter IV. *Transl Psychiatry, 1*, e40. doi:10.1038/tp.2011.33
Johansson, BB. (2000). Brain plasticity and stroke rehabilitation. The Willis lecture. *Stroke, 31*(1), 223-230.
Johansson, BB. (2004). Functional and cellular effects of environmental enrichment after experimental brain infarcts. *Restor Neurol Neurosci, 22*(3-5), 163-174.
Johansson, BB& Belichenko, PV. (2002). Neuronal plasticity and dendritic spines: effect of environmental enrichment on intact and postischemic rat brain. *J Cereb Blood Flow Metab, 22*(1), 89-96. doi:10.1097/00004647-200201000-00011
Johansson, BB& Ohlsson, AL. (1996). Environment, social interaction, and physical activity as determinants of functional outcome after cerebral infarction in the rat. *Exp Neurol, 139*(2), 322-327. doi:10.1006/exnr.1996.0106
Johnson, MJ& May, CR. (2015). Promoting professional behaviour change in healthcare: what interventions work, and why? A theory-led overview of systematic reviews. *BMJ Open, 5*(9), e008592. doi:10.1136/bmjopen-2015-008592
Jorgensen, HS, Nakayama, H, Raaschou, HO, Vive-Larsen, J, Stoier, M& Olsen, TS. (1995). Outcome and time course of recovery in stroke. Part II: Time course of recovery. The Copenhagen Stroke Study. *Arch Phys Med Rehabil, 76*(5), 406-412.
Katz-Navon, TY& Erez, M. (2005). When collective-and self-efficacy affect team performance: The role of task interdependence. *Small Group Research, 36*(4), 437-465.
Kaur, G, English, C& Hillier, S. (2013). Physiotherapists systematically overestimate the amount of time stroke survivors spend engaged in active therapy rehabilitation: an observational study. *J Physiother, 59*(1), 45-51. doi:10.1016/s1836-9553(13)70146-2
Kelley, K, Clark, B, Brown, V& Sitzia, J. (2003). Good practice in the conduct and reporting of survey research. *Int J Qual Health Care, 15*(3), 261-266.

Kenah, K, Bernhardt, J, Cumming, T, Spratt, N, Luker, J& Janssen, H. (2017). Boredom in patients with acquired brain injuries during inpatient rehabilitation: a scoping review. *Disabil Rehabil*, 1-10. doi:10.1080/09638288.2017.1354232

Khan, F, Amatya, B, Elmalik, A, Lowe, M, Ng, L, Reid, I& Galea, MP. (2016). An enriched environmental programme during inpatient neuro-rehabilitation: A randomized controlled trial. *J Rehabil Med, 48*(5), 417-425. doi:10.2340/16501977-2081

Kim, DS, Park, YG, Choi, JH, Im, SH, Jung, KJ, Cha, YA, . . . Yoon, YH. (2011). Effects of music therapy on mood in stroke patients. *Yonsei Med J, 52*(6), 977-981. doi:10.3349/ymj.2011.52.6.977

King, A, McCluskey, A& Schurr, K. (2011). The time use and activity levels of inpatients in a co-located acute and rehabilitation stroke unit: an observational study. *Top Stroke Rehabil, 18 Suppl 1*, 654-665. doi:10.1310/tsr18s01-654

Kinoshita, S, Momosaki, R, Kakuda, W, Okamoto, T& Abo, M. (2017). Association Between 7 Days Per Week Rehabilitation and Functional Recovery of Patients With Acute Stroke: A Retrospective Cohort Study Based on the Japan Rehabilitation Database. *Arch Phys Med Rehabil, 98*(4), 701-706. doi:https://doi.org/10.1016/j.apmr.2016.11.004

Knieling, M, Metz, GA, Antonow-Schlorke, I& Witte, OW. (2009). Enriched environment promotes efficiency of compensatory movements after cerebral ischemia in rats. *Neuroscience, 163*(3), 759-769. doi:10.1016/j.neuroscience.2009.07.004

Kobayashi, S, Ohashi, Y& Ando, S. (2002). Effects of enriched environments with different durations and starting times on learning capacity during aging in rats assessed by a refined procedure of the Hebb-Williams maze task. *J Neurosci Res, 70*(3), 340-346. doi:10.1002/jnr.10442

Komitova, M, Perfilieva, E, Mattsson, B, Eriksson, PS& Johansson, BB. (2006). Enriched environment after focal cortical ischemia enhances the generation of astroglia and NG2 positive polydendrocytes in adult rat neocortex. *Exp Neurol, 199*(1), 113-121. doi:10.1016/j.expneurol.2005.12.007

Komitova, M, Zhao, LR, Gido, G, Johansson, BB& Eriksson, P. (2005). Postischemic exercise attenuates whereas enriched environment has certain enhancing effects on lesion-induced subventricular zone activation in the adult rat. *Eur J Neurosci, 21*(9), 2397-2405. doi:10.1111/j.1460-9568.2005.04072.x

Kouwenhoven, SE, Kirkevold, M, Engedal, K& Kim, HS. (2011). Depression in acute stroke: prevalence, dominant symptoms and associated factors. A systematic literature review. *Disabil Rehabil, 33*(7), 539-556. doi:10.3109/09638288.2010.505997

Krakauer, JW, Carmichael, ST, Corbett, D& Wittenberg, GF. (2012). Getting neurorehabilitation right: what can be learned from animal models? *Neurorehabil Neural Repair, 26*(8), 923-931. doi:10.1177/1545968312440745

Kramer, SF, Cumming, T, Churilov, L& Bernhardt, J. (2013). Measuring activity levels at an acute stroke ward: comparing observations to a device. *Biomed Res Int, 2013*, 460482. doi:10.1155/2013/460482

Kroeders, R, Bernhardt, J& Cumming, T. (2013). Physical inactivity, depression and anxiety in acute stroke. *International Journal of Therapy and Rehabilitation, 20*(6), 289-293.

Kruithof, WJ, van Mierlo, ML, Visser-Meily, JM, van Heugten, CM& Post, MW. (2013). Associations between social support and stroke survivors' health-related quality of life--a systematic review. *Patient Educ Couns, 93*(2), 169-176. doi:10.1016/j.pec.2013.06.003

Kumar, KS, Samuelkamaleshkumar, S, Viswanathan, A& Macaden, AS. (2017). Cognitive rehabilitation for adults with traumatic brain injury to improve occupational outcomes. *Cochrane Database Syst Rev, 6*, Cd007935. doi:10.1002/14651858.CD007935.pub2

Kutlubaev, MA& Hackett, ML. (2014). Part II: predictors of depression after stroke and impact of depression on stroke outcome: an updated systematic review of observational studies. *Int J Stroke, 9*(8), 1026-1036. doi:10.1111/ijs.12356

Kwakkel, G, Kollen, B& Twisk, J. (2006). Impact of time on improvement of outcome after stroke. *Stroke, 37*(9), 2348-2353. doi:10.1161/01.STR.0000238594.91938.1e
Kwakkel, G, van Peppen, R, Wagenaar, RC, Wood Dauphinee, S, Richards, C, Ashburn, A, . . . Langhorne, P. (2004). Effects of augmented exercise therapy time after stroke: a meta-analysis. *Stroke, 35*(11), 2529-2539. doi:10.1161/01.STR.0000143153.76460.7d
Langhorne, P, Coupar, F& Pollock, A. (2009). Motor recovery after stroke: a systematic review. *Lancet Neurol, 8*(8), 741-754. doi:10.1016/s1474-4422(09)70150-4
Langhorne, P& Legg, L. (2003). Evidence behind stroke rehabilitation *Journal of Neurology, Neurosurgery, and Psychiatry, 74*(Suppl 4), iv18-iv21. doi:10.1136/jnnp.74.suppl_4.iv18
Langhorne, P& Pollock, A. (2002). What are the components of effective stroke unit care? *Age Ageing, 31*(5), 365-371.
Langhorne, P, Wu, O, Rodgers, H, Ashburn, A& Bernhardt, J. (2017). A Very Early Rehabilitation Trial after stroke (AVERT): a Phase III, multicentre, randomised controlled trial. *Health Technol Assess, 21*(54), 1-120. doi:10.3310/hta21540
Latham, K, Clarke, PJ& Pavela, G. (2015). Social Relationships, Gender, and Recovery From Mobility Limitation Among Older Americans. *J Gerontol B Psychol Sci Soc Sci, 70*(5), 769-781. doi:10.1093/geronb/gbu181
Laver, KE, George, S, Thomas, S, Deutsch, JE& Crotty, M. (2011). Virtual reality for stroke rehabilitation. *Cochrane Database Syst Rev*(9), Cd008349. doi:10.1002/14651858.CD008349.pub2
Lawrence, M& Campbell, L. (2018). Nurse education needed to address uncertainties of role and contribution in stroke rehabilitation units. *Evid Based Nurs, 21*(2), 44. doi:10.1136/eb-2017-102851
Lemieux-Charles, L& McGuire, WL. (2006). What do we know about health care team effectiveness? A review of the literature. *Med Care Res Rev, 63*(3), 263-300. doi:10.1177/1077558706287003
Lendrem, W& Lincoln, NB. (1985). Spontaneous recovery of language in patients with aphasia between 4 and 34 weeks after stroke. *J Neurol Neurosurg Psychiatry, 48*(8), 743-748.
Livingston-Thomas, J, Nelson, P, Karthikeyan, S, Antonescu, S, Jeffers, MS, Marzolini, S& Corbett, D. (2016). Exercise and Environmental Enrichment as Enablers of Task-Specific Neuroplasticity and Stroke Recovery. *Neurotherapeutics, 13*(2), 395-402. doi:10.1007/s13311-016-0423-9
Lockhart, L, James, I& Linstead, G. (2006). *Mind the Gap: Ways to enhance therapy provision in stroke rehabilitation. NHS Improvement Stroke*.
Loft, MI, Martinsen, B, Esbensen, BA, Mathiesen, LL, Iversen, HK& Poulsen, I. (2017). Call for human contact and support: an interview study exploring patients' experiences with inpatient stroke rehabilitation and their perception of nurses' and nurse assistants' roles and functions. *Disabil Rehabil*, 1-9. doi:10.1080/09638288.2017.1393698
Lok, P, Rhodes, J& Westwood, B. (2011). The mediating role of organizational subcultures in health care organizations. *J Health Organ Manag, 25*(5), 506-525. doi:10.1108/14777261111161860
Luker, J, Lynch, E, Bernhardsson, S, Bennett, L& Bernhardt, J. (2015). Stroke survivors' experiences of physical rehabilitation after stroke: a systematic review of qualitative studies. *Arch Phys Med Rehabil, 96*. doi:10.1016/j.apmr.2015.03.017
Luker, J, Murray, C, Lynch, E, Bernhardsson, S, Shannon, M& Bernhardt, J. (2017). Carers' Experiences, Needs, and Preferences During Inpatient Stroke Rehabilitation: A Systematic Review of Qualitative Studies. *Arch Phys Med Rehabil, 98*(9), 1852-1862.e1813. doi:10.1016/j.apmr.2017.02.024
Luker, JA, Craig, LE, Bennett, L, Ellery, F, Langhorne, P, Wu, O& Bernhardt, J. (2016). Implementing a complex rehabilitation intervention in a stroke trial: a qualitative process evaluation of AVERT. *BMC Medical Research Methodology, 16*(1), 52. doi:10.1186/s12874-016-0156-9

Lutz, BJ, Young, ME, Cox, KJ, Martz, C& Creasy, KR. (2011). The crisis of stroke: experiences of patients and their family caregivers. *Top Stroke Rehabil, 18*(6), 786-797. doi:10.1310/tsr1806-786

Maben, J, Griffiths, P, Penfold, C, Simon, M, Anderson, JE, Robert, G, . . . Barlow, J. (2016). One size fits all? Mixed methods evaluation of the impact of 100% single-room accommodation on staff and patient experience, safety and costs. *BMJ Qual Saf, 25*(4), 241-256. doi:10.1136/bmjqs-2015-004265

Mackey, F, Ada, L, Heard, R& Adams, R. (1996). Stroke rehabilitation: are highly structured units more conducive to physical activity than less structured units? *Arch Phys Med Rehabil, 77*(10), 1066-1070.

Magee, WL, Clark, I, Tamplin, J& Bradt, J. (2017). Music interventions for acquired brain injury. *Cochrane Database of Systematic Reviews*(1). doi:10.1002/14651858.CD006787.pub3

Mallet, KH, Shamloul, RM, Corbett, D, Finestone, HM, Hatcher, S, Lumsden, J, . . . Dowlatshahi, D. (2016). RecoverNow: Feasibility of a Mobile Tablet-Based Rehabilitation Intervention to Treat Post-Stroke Communication Deficits in the Acute Care Setting. *PLOS ONE, 11*(12), e0167950. doi:10.1371/journal.pone.0167950

Mattlage, AE, Redlin, SA, Rippee, MA, Abraham, MG, Rymer, MM& Billinger, SA. (2015). Use of Accelerometers to Examine Sedentary Time on an Acute Stroke Unit. *J Neurol Phys Ther, 39*(3), 166-171. doi:10.1097/npt.0000000000000092

McCluskey, A, Ada, L, Kelly, PJ, Middleton, S, Goodall, S, Grimshaw, JM, . . . Karageorge, A. (2016). A behavior change program to increase outings delivered during therapy to stroke survivors by community rehabilitation teams: The Out-and-About trial. *Int J Stroke, 11*(4), 425-437. doi:10.1177/1747493016632246

McCluskey, A& O'Connor, D. (2017). Implementing and sustaining practice change In T.Hoffmann, S.Bennet, & C.DelMar (Eds.), *Evidence-based practice across the health professions* (3rd ed;pp 384-408 ed.). Sydney: Elsevier.

Mead, GE, Wardlaw, JM, Dennis, MS, Lewis, SC& Warlow, CP. (2000). Relationship between pattern of intracranial artery abnormalities on transcranial doppler and Oxfordshire Community Stroke Project clinical classification of ischemic stroke. *Stroke, 31*(3), 714-719.

Mehrholz, J, Wagner, K, Rutte, K, Meissner, D& Pohl, M. (2007). Predictive validity and responsiveness of the functional ambulation category in hemiparetic patients after stroke. *Arch Phys Med Rehabil, 88*(10), 1314-1319. doi:10.1016/j.apmr.2007.06.764

Meiner, Z, Sajin, A, Schwartz, I, Tsenter, J, Yovchev, I, Eichel, R, . . . Leker, RR. (2010). Rehabilitation outcomes of stroke patients treated with tissue plasminogen activator. *Pm r, 2*(8), 698-702; quiz 792. doi:10.1016/j.pmrj.2010.04.029

Mering, S& Jolkkonen, J. (2015). Proper housing conditions in experimental stroke studies-special emphasis on environmental enrichment. *Front Neurosci, 9*, 106. doi:10.3389/fnins.2015.00106

Meyer, S, Verheyden, G, Brinkmann, N, Dejaeger, E, De Weerdt, W, Feys, H, . . . De Wit, L. (2015). Functional and motor outcome 5 years after stroke is equivalent to outcome at 2 months: follow-up of the collaborative evaluation of rehabilitation in stroke across Europe. *Stroke, 46*(6), 1613-1619. doi:10.1161/strokeaha.115.009421

Middleton, S, McElduff, P, Ward, J, Grimshaw, JM, Dale, S, D'Este, C, . . . Levi, C. (2011). Implementation of evidence-based treatment protocols to manage fever, hyperglycaemia, and swallowing dysfunction in acute stroke (QASC): a cluster randomised controlled trial. *Lancet, 378*(9804), 1699-1706. doi:10.1016/s0140-6736(11)61485-2

Moore, GF, Audrey, S, Barker, M, Bond, L, Bonell, C, Hardeman, W, . . . Baird, J. (2015). Process evaluation of complex interventions: Medical Research Council guidance. *Bmj, 350*, h1258. doi:10.1136/bmj.h1258

Mouawad, MR, Doust, CG, Max, MD& McNulty, PA. (2011). Wii-based movement therapy to promote improved upper extremity function post-stroke: a pilot study. *J Rehabil Med, 43*(6), 527-533. doi:10.2340/16501977-0816

Mozaffarian, D, Benjamin, EJ, Go, AS, Arnett, DK, Blaha, MJ, Cushman, M, . . . Turner, MB. (2015). Heart Disease and Stroke Statistics—2016 Update. *A Report From the American Heart Association*. doi:10.1161/cir.0000000000000350

Mudge, AM, McRae, P& Cruickshank, M. (2015). Eat walk engage: an interdisciplinary collaborative model to improve care of hospitalized elders. *Am J Med Qual, 30*(1), 5-13. doi:10.1177/1062860613510965

Munce, SEP, Graham, ID, Salbach, NM, Jaglal, SB, Richards, CL, Eng, JJ, . . . Bayley, MT. (2017). Perspectives of health care professionals on the facilitators and barriers to the implementation of a stroke rehabilitation guidelines cluster randomized controlled trial. *BMC Health Serv Res, 17*(1), 440. doi:10.1186/s12913-017-2389-7

National NHS Staff Survey Co-ordination Centre. (2012). *Focused on staff experience*. Oxford, UK Retrieved from http://www.nhsstaffsurveys.com/Page/1037/Past-Results/Staff-Survey-2012-Detailed-Spreadsheets/.

New South Wales Government. (2015). *Allied Health Assistant Framework*.

Nithianantharajah, J& Hannan, AJ. (2006). Enriched environments, experience-dependent plasticity and disorders of the nervous system. *Nat Rev Neurosci, 7*(9), 697-709. doi:10.1038/nrn1970

Nursiswati, N, Halfens, RJG& Lohrmann, C. (2017). Change in Care Dependency of Stroke Patients: A Longitudinal and Multicenter Study. *Asian Nurs Res (Korean Soc Nurs Sci), 11*(2), 113-118. doi:10.1016/j.anr.2017.05.005

Nygren, J& Wieloch, T. (2005). Enriched environment enhances recovery of motor function after focal ischemia in mice, and downregulates the transcription factor NGFI-A. *J Cereb Blood Flow Metab, 25*(12), 1625-1633. doi:10.1038/sj.jcbfm.9600157

Nys, GM, van Zandvoort, MJ, de Kort, PL, Jansen, BP, de Haan, EH& Kappelle, LJ. (2007). Cognitive disorders in acute stroke: prevalence and clinical determinants. *Cerebrovasc Dis, 23*(5-6), 408-416. doi:10.1159/000101464

Occupational Therapy Australia. (2015). *Position paper: The role of allied health assistants in supporting occupational theray practice*.

Office for National Statistics. (2017). *Population Estimates for UK, England and Wales, Scotland and Northern Ireland: mid-2016*.

Ohlsson, AL& Johansson, BB. (1995). Environment influences functional outcome of cerebral infarction in rats. *Stroke, 26*(4), 644-649.

Ostwald, SK, Godwin, KM, Ye, F& Cron, SG. (2013). Serious adverse events experienced by survivors of stroke in the first year following discharge from inpatient rehabilitation. *Rehabil Nurs, 38*(5), 254-263. doi:10.1002/rnj.87

Otterman, NM, van der Wees, PJ, Bernhardt, J& Kwakkel, G. (2012). Physical therapists' guideline adherence on early mobilization and intensity of practice at dutch acute stroke units: a country-wide survey. *Stroke, 43*(9), 2395-2401. doi:10.1161/strokeaha.112.660092

Palinkas, LA, Horwitz, SM, Green, CA, Wisdom, JP, Duan, N& Hoagwood, K. (2015). Purposeful Sampling for Qualitative Data Collection and Analysis in Mixed Method Implementation Research. *Adm Policy Ment Health, 42*(5), 533-544. doi:10.1007/s10488-013-0528-y

Patton, M. (2015). *Qualitative Research & Evaluating Methods* (Fourth Edition ed.): SAGE Publications, Inc.

Paul, L, Brewster, S, Wyke, S, Gill, JM, Alexander, G, Dybus, A& Rafferty, D. (2016). Physical activity profiles and sedentary behaviour in people following stroke: a cross-sectional study. *Disabil Rehabil, 38*(4), 362-367. doi:10.3109/09638288.2015.1041615

Peiris, CL, Shields, N, Brusco, NK, Watts, JJ& Taylor, NF. (2013). Additional Saturday rehabilitation improves functional independence and quality of life and reduces length of stay: a randomized controlled trial. *BMC Med, 11*, 198. doi:10.1186/1741-7015-11-198

Pennington, H& Isles, C. (2013). Should hospitals provide all patients with single rooms? *Bmj, 347*, f5695. doi:10.1136/bmj.f5695

Pincherle, A, Pace, M, Sarasso, S, Facchin, L, Dreier, JP& Bassetti, CL. (2017). Sleep, Preconditioning and Stroke. *Stroke, 48*(12), 3400-3407. doi:10.1161/strokeaha.117.018796

Powers, WJ, Rabinstein, AA, Ackerson, T, Adeoye, OM, Bambakidis, NC, Becker, K, . . . Tirschwell, DL. (2018). 2018 Guidelines for the Early Management of Patients With Acute Ischemic Stroke: A Guideline for Healthcare Professionals From the American Heart Association/American Stroke Association. *Stroke, 49*(3), e46-e110. doi:10.1161/str.0000000000000158

Preston, E, Dean, CM, Ada, L, Stanton, R, Brauer, S, Kuys, S& Waddington, G. (2017). Promoting physical activity after stroke via self-management: a feasibility study. *Top Stroke Rehabil, 24*(5), 353-360. doi:10.1080/10749357.2017.1304876

Quinn, TJ, Dawson, J, Walters, MR& Lees, KR. (2008). Variability in modified Rankin scoring across a large cohort of international observers. *Stroke, 39*(11), 2975-2979. doi:10.1161/strokeaha.108.515262

Quinn, TJ, Paolucci, S, Sunnerhagen, KS, Sivenius, J, Walker, MF, Toni, D& Lees, KR. (2009). Evidence-based stroke r-ehabilitation: an expanded guidance document from the european stroke organisation (ESO) guidelines for management of ischaemic stroke and transient ischaemic attack 2008. *J Rehabil Med, 41*(2), 99-111. doi:10.2340/16501977-0301

Quinn, TJ, Taylor-Rowan, M, Coyte, A, Clark, AB, Musgrave, SD, Metcalf, AK, . . . Myint, PK. (2017). Pre-Stroke Modified Rankin Scale: Evaluation of Validity, Prognostic Accuracy, and Association with Treatment. *Frontiers in Neurology, 8*, 275. doi:10.3389/fneur.2017.00275

Redfern, J, McKevitt, C& Wolfe, CD. (2006). Development of complex interventions in stroke care: a systematic review. *Stroke, 37*(9), 2410-2419. doi:10.1161/01.STR.0000237097.00342.a9

Risedal, A, Mattsson, B, Dahlqvist, P, Nordborg, C, Olsson, T& Johansson, BB. (2002). Environmental influences on functional outcome after a cortical infarct in the rat. *Brain Research Bulletin, 58*(3), 315-321. doi:https://doi.org/10.1016/S0361-9230(02)00796-7

Risedal, A, Zeng, J& Johansson, BB. (1999). Early training may exacerbate brain damage after focal brain ischemia in the rat. *J Cereb Blood Flow Metab, 19*(9), 997-1003. doi:10.1097/00004647-199909000-00007

Rosbergen, I, Grimley, R, Hayward, K, Walker, K, Rowley, D, Campbell, A, . . . Brauer, S. (2017). Embedding an enriched environment in an acute stroke unit increases activity in people with stroke: a controlled before–after pilot study. *Clin Rehabil, 31*(11), 1516-1528. doi:10.1177/0269215517705181

Rosbergen, ICM, Grimley, RS, Hayward, KS, Walker, KC, Rowley, D, Campbell, AM, . . . Brauer, SG. (2016). The effect of an enriched environment on activity levels in people with stroke in an acute stroke unit: protocol for a before-after pilot study. *Pilot and Feasibility Studies, 2*(1), 36. doi:10.1186/s40814-016-0081-z

Rosenzweig, MR, Krech, D, Bennett, EL& Diamond, MC. (1962). Effects of environmental complexity and training on brain chemistry and anatomy: a replication and extension. *J Comp Physiol Psychol, 55*, 429-437.

Rosewilliam, S, Roskell, CA& Pandyan, AD. (2011). A systematic review and synthesis of the quantitative and qualitative evidence behind patient-centred goal setting in stroke rehabilitation. *Clin Rehabil, 25*(6), 501-514. doi:10.1177/0269215510394467

Royal College of Physicians. (2016). *National Clinical Guideline for Stroke*. United Kingdom.

Ryan, RM& Deci, EL. (2000). Intrinsic and Extrinsic Motivations: Classic Definitions and New Directions. *Contemporary Educational Psychology, 25*(1), 54-67. doi:http://dx.doi.org/10.1006/ceps.1999.1020

Sale, A, Berardi, N& Maffei, L. (2009). Enrich the environment to empower the brain. *Trends in Neurosciences, 32*(4), 233-239. doi:https://doi.org/10.1016/j.tins.2008.12.004

Sarkamo, T, Ripolles, P, Vepsalainen, H, Autti, T, Silvennoinen, HM, Salli, E, . . . Rodriguez-Fornells, A. (2014). Structural changes induced by daily music listening in the recovering brain after middle cerebral artery stroke: a voxel-based morphometry study. *Front Hum Neurosci, 8*, 245. doi:10.3389/fnhum.2014.00245

Sarkamo, T, Tervaniemi, M, Laitinen, S, Forsblom, A, Soinila, S, Mikkonen, M, . . . Hietanen, M. (2008). Music listening enhances cognitive recovery and mood after middle cerebral artery stroke. *Brain, 131*(Pt 3), 866-876. doi:10.1093/brain/awn013

Schneider, EJ, Lannin, NA, Ada, L& Schmidt, J. (2016). Increasing the amount of usual rehabilitation improves activity after stroke: a systematic review. *J Physiother, 62*(4), 182-187. doi:10.1016/j.jphys.2016.08.006

Schouten, LM, Hulscher, ME, Akkermans, R, van Everdingen, JJ, Grol, RP& Huijsman, R. (2008). Factors that influence the stroke care team's effectiveness in reducing the length of hospital stay. *Stroke, 39*(9), 2515-2521. doi:10.1161/strokeaha.107.510537

Scottisch Government. (2008). *Single room provision steering group report.* Retrieved from http://www.gov.scot/resource/doc/253500/0075129.pdf.

Scrivener, K, Jones, T, Schurr, K, Graham, PL& Dean, CM. (2015). After-hours or weekend rehabilitation improves outcomes and increases physical activity but does not affect length of stay: a systematic review. *Journal of Physiotherapy, 61*(2), 61-67. doi:https://doi.org/10.1016/j.jphys.2015.02.017

Scrivener, K, Tourany, R, McNamara-Holmes, M, Schurr, K, Dorsch, S& Dean, C. (2017). Feasibility of a Nurse-Led Weekend Group Exercise Program for People after Stroke. *Stroke Res Treat, 2017*, 4574385. doi:10.1155/2017/4574385

Shah, S, Vanclay, F& Cooper, B. (1989). Improving the sensitivity of the Barthel Index for stroke rehabilitation. *J Clin Epidemiol, 42*(8), 703-709.

Shannon, MM, Elf, M, Churilov, L, Olver, J, Pert, A& Bernhardt, J. (2018). Can the physical environment itself influence neurological patient activity? *Disabil Rehabil*, 1-13. doi:10.1080/09638288.2017.1423520

Shenton, AK. (2004). Strategies for ensuring trustworthiness in qualitative research projects. *Education for information, 22*(2), 63-75.

Simondson, JA, Goldie, P& Greenwood, KM. (2003). The Mobility Scale for Acute Stroke Patients: concurrent validity. *Clin Rehabil, 17*(5), 558-564.

Simpson, J& Kelly, JP. (2011). The impact of environmental enrichment in laboratory rats--behavioural and neurochemical aspects. *Behav Brain Res, 222*(1), 246-264. doi:10.1016/j.bbr.2011.04.002

Skarin, M, Sjoholm, A, Nilsson, A, Nilsson, M, Bernhardt, J& Linden, T. (2013). A mapping study on physical activity in stroke rehabilitation: establishing the baseline. *J Rehabil Med, 45*(10), 997-1003. doi:10.2340/16501977-1214

Skidmore, ER, Dawson, DR, Butters, MA, Grattan, ES, Juengst, SB, Whyte, EM, . . . Becker, JT. (2015). Strategy Training Shows Promise for Addressing Disability in the First 6 Months After Stroke. *Neurorehabil Neural Repair, 29*(7), 668-676. doi:10.1177/1545968314562113

Somerville, L, Davis, A, Milne, S, Terrill, D& Philip, K. (2017). Exploration of an allied health workforce redesign model: quantifying the work of allied health assistants in a community workforce. *Aust Health Rev*. doi:10.1071/ah16266

Stajkovic, AD, Lee, D& Nyberg, AJ. (2009). Collective efficacy, group potency, and group performance: meta-analyses of their relationships, and test of a mediation model. *J Appl Psychol, 94*(3), 814-828. doi:10.1037/a0015659

Stamatakis, E, Hamer, M& Dunstan, DW. (2011). Screen-based entertainment time, all-cause mortality, and cardiovascular events: population-based study with ongoing mortality and hospital events follow-up. *J Am Coll Cardiol, 57*(3), 292-299. doi:10.1016/j.jacc.2010.05.065

State Government of Victoria. (2012). *Supervision and delegation framework for allied health assistants, Department of Health*.

Statistics Canada. (2017). *Canada at a Glance 2017*. Retrieved from http://www.statcan.gc.ca/pub/12-581-x/2017000/pop-eng.htm.

Steering Committee for the Review of Government Service Provision. (2005). *Review of patient satisfaction and experience surveys conducted for public hospitals in Australia*. Canberra.

Stetler, CB. (2003). Role of the organization in translating research into evidence-based practice. *Outcomes Manag, 7*(3), 97-103; quiz 104-105.
Stroke Association. (2017). *Current, future and avoidable costs of stroke in the UK*. London.
Stroke Foundation. (2007). *Walk in our shoes: stroke survivors and carers report on support after stroke.* Melbourne, Australia.
Stroke Foundation. (2010). *Clinical Guidelines for Stroke Management 2010*. Melbourne Australia.
Stroke Foundation. (2015). *National Acute Stroke Services, Framework 2015*. Melbourne Australia.
Stroke Foundation. (2016). *National Stroke Audit - Rehabilitation Services Report 2016*. Melbourne Australia.
Stroke Foundation. (2017a). *Clinical Guidelines for Stroke Management 2017*. Melbourne Australia.
Stroke Foundation. (2017b). *National Stroke Audit - Acute Services Report 2017*. Melbourne Australia.
Stroke Foundation. (2017c). *No postcode untouched - Stroke in Australia 2017*. Melbourne Australia.
Stroke Unit Trialists Collaboration. (1997). Collaborative systematic review of the randomised trials of organised inpatient (stroke unit) care after stroke. Stroke Unit Trialists' Collaboration. *Bmj, 314*(7088), 1151-1159.
Stroke Unit Trialists' Collaboration. (2007). Organised inpatient (stroke unit) care for stroke. *Cochrane Database Syst Rev*(4), Cd000197. doi:10.1002/14651858.CD000197.pub2
Stroke Unit Trialists' Collaboration. (2013). Organised inpatient (stroke unit) care for stroke. *Cochrane Database Syst Rev, 9*, Cd000197. doi:10.1002/14651858.CD000197.pub3
Sullivan, GM& Artino, AR. (2013). Analyzing and Interpreting Data From Likert-Type Scales. *Journal of Graduate Medical Education, 5*(4), 541-542. doi:10.4300/JGME-5-4-18
Taylor, N, Clay-Williams, R, Hogden, E, Braithwaite, J& Groene, O. (2015). High performing hospitals: a qualitative systematic review of associated factors and practical strategies for improvement. *BMC Health Serv Res, 15*. doi:10.1186/s12913-015-0879-z
Thomas, LH, French, B, Coupe, J, McMahon, N, Connell, L, Harrison, J, . . . Watkins, CL. (2017). Repetitive Task Training for Improving Functional Ability After Stroke: A Major Update of a Cochrane Review. *Stroke, 48*(4), e102-e103. doi:10.1161/strokeaha.117.016503
Thrift, AG, Dewey, HM, Macdonell, RA, McNeil, JJ& Donnan, GA. (2000). Stroke incidence on the east coast of Australia: the North East Melbourne Stroke Incidence Study (NEMESIS). *Stroke, 31*(9), 2087-2092.
Tieges, Z, Mead, G, Allerhand, M, Duncan, F, van Wijck, F, Fitzsimons, C, . . . Chastin, S. (2015). Sedentary behavior in the first year after stroke: a longitudinal cohort study with objective measures. *Arch Phys Med Rehabil, 96*(1), 15-23. doi:10.1016/j.apmr.2014.08.015
Tong, A, Sainsbury, P& Craig, J. (2007). Consolidated criteria for reporting qualitative research (COREQ): a 32-item checklist for interviews and focus groups. *Int J Qual Health Care, 19*(6), 349-357. doi:10.1093/intqhc/mzm042
Towfighi, A, Ovbiagele, B, El Husseini, N, Hackett, ML, Jorge, RE, Kissela, BM, . . . Williams, LS. (2017). Poststroke Depression: A Scientific Statement for Healthcare Professionals From the American Heart Association/American Stroke Association. *Stroke, 48*(2), e30-e43. doi:10.1161/str.0000000000000113
Tsai, PL, Chen, MC, Huang, YT, Lin, KC, Chen, KL& Hsu, YW. (2013). Listening to classical music ameliorates unilateral neglect after stroke. *Am J Occup Ther, 67*(3), 328-335. doi:10.5014/ajot.2013.006312
Tsouna-Hadjis, E, Vemmos, KN, Zakopoulos, N& Stamatelopoulos, S. (2000). First-stroke recovery process: the role of family social support. *Arch Phys Med Rehabil, 81*(7), 881-887. doi:10.1053/apmr.2000.4435
Ulrich, RS. (1984). View through a window may influence recovery from surgery. *Science, 224*(4647), 420-421. doi:10.1126/science.6143402

van den Berg, M, Crotty, MP, Liu, E, Killington, M, Kwakkel, GP& van Wegen, E. (2016). Early Supported Discharge by Caregiver-Mediated Exercises and e-Health Support After Stroke: A Proof-of-Concept Trial. *Stroke, 47*(7), 1885-1892. doi:10.1161/strokeaha.116.013431

van Hoof, J, Rutten, PGS, Struck, C, Huisman, ERCM& Kort, HSM. (2015). The integrated and evidence-based design of healthcare environments. *Architectural Engineering and Design Management, 11*(4), 243-263. doi:10.1080/17452007.2014.892471

Van Remoortel, H, Giavedoni, S, Raste, Y, Burtin, C, Louvaris, Z, Gimeno-Santos, E, . . . Troosters, T. (2012). Validity of activity monitors in health and chronic disease: a systematic review. *Int J Behav Nutr Phys Act, 9*, 84. doi:10.1186/1479-5868-9-84

Veerbeek, JM, Kwakkel, G, van Wegen, EE, Ket, JC& Heymans, MW. (2011). Early prediction of outcome of activities of daily living after stroke: a systematic review. *Stroke, 42*(5), 1482-1488. doi:10.1161/strokeaha.110.604090

Veerbeek, JM, van Wegen, E, van Peppen, R, van der Wees, PJ, Hendriks, E, Rietberg, M& Kwakkel, G. (2014). What is the evidence for physical therapy poststroke? A systematic review and meta-analysis. *PLoS One, 9*(2), e87987. doi:10.1371/journal.pone.0087987

Venna, VR, Xu, Y, Doran, SJ, Patrizz, A& McCullough, LD. (2014). Social interaction plays a critical role in neurogenesis and recovery after stroke. *Transl Psychiatry, 4*, e351. doi:10.1038/tp.2013.128

Virani, T, Lemieux-Charles, L, Davis, DA& Berta, W. (2009). Sustaining change: once evidence-based practices are transferred, what then? *Healthc Q, 12*(1), 89-96, 82.

Vloothuis, JD, Mulder, M, Veerbeek, JM, Konijnenbelt, M, Visser-Meily, JM, Ket, JC, . . . van Wegen, EE. (2016). Caregiver-mediated exercises for improving outcomes after stroke. *Cochrane Database Syst Rev, 12*, Cd011058. doi:10.1002/14651858.CD011058.pub2

Vratsistas-Curto, A, McCluskey, A& Schurr, K. (2017). Use of audit, feedback and education increased guideline implementation in a multidisciplinary stroke unit. *BMJ Open Qual, 6*(2), e000212. doi:10.1136/bmjoq-2017-000212

Walker, MF, Hoffmann, TC, Brady, MC, Dean, CM, Eng, JJ, Farrin, AJ, . . . Watkins, CL. (2017). Improving the development, monitoring and reporting of stroke rehabilitation research: Consensus-based core recommendations from the Stroke Recovery and Rehabilitation Roundtable. *Int J Stroke, 12*(5), 472-479. doi:10.1177/1747493017711815

Wallin, L, Profetto-McGrath, J& Levers, MJ. (2005). Implementing nursing practice guidelines: a complex undertaking. *J Wound Ostomy Continence Nurs, 32*(5), 294-300; discussion 300-291.

Walsh, RN. (1981). Effects of environmental complexity and deprivation on brain anatomy and histology: a review. *Int J Neurosci, 12*(1), 33-51.

Ward, NS. (2017). Restoring brain function after stroke — bridging the gap between animals and humans. *Nature Reviews Neurology, 13*, 244. doi:10.1038/nrneurol.2017.34

West, T& Bernhardt, J. (2012). Physical Activity in Hospitalised Stroke Patients. *Stroke Res Treat, 2012*. doi:10.1155/2012/813765

Westerterp, KR. (2009). Assessment of physical activity: a critical appraisal. *Eur J Appl Physiol, 105*(6), 823-828. doi:10.1007/s00421-009-1000-2

White, J, Janssen, H, Jordan, L& Pollack, M. (2015a). Tablet technology during stroke recovery: a survivor's perspective. *Disabil Rehabil, 37*(13), 1186-1192. doi:10.3109/09638288.2014.958620

White, JH, Alborough, K, Janssen, H, Spratt, N, Jordan, L& Pollack, M. (2014). Exploring staff experience of an "enriched environment" within stroke rehabilitation: a qualitative sub-study. *Disabil Rehabil, 36*(21), 1783-1789. doi:10.3109/09638288.2013.872200

White, JH, Bartley, E, Janssen, H, Jordan, LA& Spratt, N. (2015b). Exploring stroke survivor experience of participation in an enriched environment: a qualitative study. *Disabil Rehabil, 37*(7), 593-600. doi:10.3109/09638288.2014.935876

Winters, C, van Wegen, EE, Daffertshofer, A& Kwakkel, G. (2015). Generalizability of the Proportional Recovery Model for the Upper Extremity After an Ischemic Stroke. *Neurorehabil Neural Repair, 29*(7), 614-622. doi:10.1177/1545968314562115

Winters, C, van Wegen, EE, Daffertshofer, A& Kwakkel, G. (2017). Generalizability of the Maximum Proportional Recovery Rule to Visuospatial Neglect Early Poststroke. *Neurorehabil Neural Repair, 31*(4), 334-342. doi:10.1177/1545968316680492

Worrall, L& Foster, A. (2017). Does intensity matter in aphasia rehabilitation? *Lancet, 389*(10078), 1494-1495. doi:10.1016/s0140-6736(17)30546-9

Xu, X, Ye, L& Ruan, Q. (2009). Environmental enrichment induces synaptic structural modification after transient focal cerebral ischemia in rats. *Exp Biol Med (Maywood), 234*(3), 296-305. doi:10.3181/0804-rm-128

Yagi, M, Yasunaga, H, Matsui, H, Morita, K, Fushimi, K, Fujimoto, M, . . . Fujitani, J. (2017). Impact of Rehabilitation on Outcomes in Patients With Ischemic Stroke: A Nationwide Retrospective Cohort Study in Japan. *Stroke, 48*(3), 740-746. doi:10.1161/strokeaha.116.015147

Yong Joo, L, Soon Yin, T, Xu, D, Thia, E, Pei Fen, C, Kuah, CW& Kong, KH. (2010). A feasibility study using interactive commercial off-the-shelf computer gaming in upper limb rehabilitation in patients after stroke. *J Rehabil Med, 42*(5), 437-441. doi:10.2340/16501977-0528

Yu, K, Wu, Y, Zhang, Q, Xie, H, Liu, G, Guo, Z, . . . Hu, R. (2014). Enriched environment induces angiogenesis and improves neural function outcomes in rat stroke model. *J Neurol Sci, 347*(1-2), 275-280. doi:10.1016/j.jns.2014.10.022

Zeiler, SR, Hubbard, R, Gibson, EM, Zheng, T, Ng, K, O'Brien, R& Krakauer, JW. (2016). Paradoxical Motor Recovery From a First Stroke After Induction of a Second Stroke: Reopening a Postischemic Sensitive Period. *Neurorehabil Neural Repair, 30*(8), 794-800. doi:10.1177/1545968315624783

Zeiler, SR& Krakauer, JW. (2013). The interaction between training and plasticity in the poststroke brain. *Curr Opin Neurol, 26*(6), 609-616. doi:10.1097/wco.0000000000000025

Zhang, X, Chen, XP, Lin, JB, Xiong, Y, Liao, WJ& Wan, Q. (2017). Effect of enriched environment on angiogenesis and neurological functions in rats with focal cerebral ischemia. *Brain Res, 1655*, 176-185. doi:10.1016/j.brainres.2016.11.001

Zucchella, C, Capone, A, Codella, V, Vecchione, C, Buccino, G, Sandrini, G, . . . Bartolo, M. (2014). Assessing and restoring cognitive functions early after stroke. *Funct Neurol, 29*(4), 255-262.

Appendices

Appendix 1 Human Research Ethics Committee Approval

Enquiries to: R&ETPCH@health.qld.gov.au
Office Ph: (07) 3139 4198
(07) 3139 4500
Our Ref: HREC Final Approval

Queensland Government

5 March 2014

Human Research Ethics Committee
Metro North Hospital and Health Service
The Prince Charles Hospital
Administration Building, Lower Ground
Rode Road, Chermside QLD 4032

Mrs Ingrid Rosbergen
Physiotherapy Service
Nambour General Hospital
PO Box 547
Nambour, QLD 4560

Dear Mrs Rosbergen

HREC/14/QPCH/21: Phase I trial: Feasibility of creating an enriched environment and subsequent impact on activity levels for stroke patients in an Acute Stroke Unit.

This project was considered by Metro North Hospital and Health Service - The Prince Charles Hospital Human Research Ethics Committee (HREC).

This HREC is constituted and operates in accordance with the National Health and Medical Research Council's (NHMRC) *National Statement on Ethical Conduct in Human Research (2007), NHMRC and Universities Australia Australian Code for the Responsible Conduct of Research (2007)* and the *CPMP/ICH Note for Guidance on Good Clinical Practice*.

I am pleased to advise that the Human Research Ethics Committee has granted final approval of this research project. The documents reviewed and approved for the above mentioned project include:

Document	*Version*	*Date*
Application **(AU/1/B8B6115)**		
Participant Information Sheet and Consent Form: Stroke Survivor	1.0	25 January 2014
Participant Information Sheet and Consent Form: Substitute Decision Maker	1.0	25 January 2014
Participant Information Sheet and Consent Form: Carer and Clinical Staff	1.0	25 January 2014
Protocol: EESI Research Protocol	1.0	21 December 2013
Questionnaire: EESI Patient Survey	1.0	29 January 2014
Questionnaire: EESI Carers Survey	1.0	29 January 2014
Questionnaire: EESI Clinical Staff Survey	1.0	29 January 2014
EESI Behavioral Mapping Protocol	1.0	24 January 2014
EESI Behavioral Mapping Explanation Document	1.0	24 January 2014
EESI Observation Recording Sheet	1.0	25 January 2014

EESI Adverse Event Form	1.0	06 February 2014
EESI Serious Adverse Event Form	1.0	06 February 2014
EESI Program	1.0	25 January 2014

Please note the following conditions of approval:

1. The Principal Investigator will immediately report anything which might warrant review of ethical approval of the project in the specified format, including:

    a. Unforeseen events that might affect continued ethical acceptability of the project.

    b. Serious Adverse Events that materially impact on the continued ethical acceptability of the project. In addition the Investigator must provide, at least six monthly, a summary of serious adverse events, in the specified format, including a comment as to suspected causality.

2. Amendments to the research project which may affect the ongoing ethical acceptability of a project must be submitted to the HREC for review. Major amendments should be reflected in a cover letter from the principal investigator, providing a description of the changes, the rationale for the changes, and their implications for the ongoing conduct of the study. Hard copies of the revised amendments, the cover letter and all relevant updated documents with tracked changes must also be submitted to the HREC coordinator as per standard HREC SOP. Further advice on submitting amendments is available from http://www.health.qld.gov.au/ohmr/html/regu/regu_home.asp

3. Amendments to the research project which only affect the ongoing site acceptability of the project are not required to be submitted to the HREC for review. These amendment requests should be submitted directly to the Research Governance Office/r (by-passing the HREC).

4. Proposed amendments to the research project which may affect both the ethical acceptability and site suitability of the project must be submitted firstly the HREC for review and, once HREC approval has been granted, submitted to the RGO.

5. Amendments which do not affect either the ethical acceptability or site acceptability of the project (e.g. typographical errors) should be submitted in hard copy to the HREC coordinator. These should include a cover letter from the principal investigator providing a brief description of the changes and the rationale for the changes, and accompanied by all relevant updated documents with tracked changes.

6. The HREC will be notified, giving reasons, if the project is discontinued at a site before the expected date of completion.

7. The Principal Investigator will provide an annual report to the HREC and at completion of the study in the specified format.

8. The Hospital & Health Service Administration and the Human Research Ethics Committee may inquire into the conduct of any research or purported research, whether approved or not and regardless of the source of funding, being conducted on hospital premises or claiming any association with the Hospital; or which the Committee has approved if conducted outside The Prince Charles Hospital & Health Services.

HREC approval is valid for **3 years** from the date of this letter.

Should you have any queries about the HREC's consideration of your project please contact the Executive Officer on the above phone numbers or email addresses. The HREC terms of Reference, Standard Operating Procedures, membership and standard forms are available from http://www.health.qld.gov.au/ohmr/html/regu/regu_home.asp

You are reminded that this letter constitutes ethical approval only. **You must not commence this research project at a site until separate authorisation from the Hospital & Health Services CEO or Delegate of that site has been obtained.**

A copy of this approval must be submitted to the relevant Hospital & Health Services Research Governance Officer/s or Delegated Personnel with a completed Site Specific Assessment (SSA) Form for authorisation from the CEO or Delegate to conduct this research at the site/s.

Once authorisation to conduct the research has been granted, please complete the Commencement Form http://www.health.qld.gov.au/tpch/documents/form_notification.dot and return to the office of the Human Research Ethics Committee.

The HREC wishes you every success in your research.

Yours faithfully

Dr Russell Denman
Chair
HUMAN RESEARCH ETHICS COMMITTEE
METRO NORTH HOSPITAL AND HEALTH SERVICE

List of approved Sites:

No.	Site
1.	Nambour Hospital

Appendix 2 Institutional Human Research Ethics Approval

THE UNIVERSITY OF QUEENSLAND

Institutional Human Research Ethics Approval

Project Title:	Phase I Trial: Feasibility Of Creating An Enriched Environment And Subsequent Impact On Activity Levels For Stroke Patients In An Acute Stroke Unit
Chief Investigator:	Mrs Ingrid Rosbergen, Prof Sandy Brauer, Dr Rohan Grimley, Dr Kathryn Hayward
Supervisor:	Prof Sandy Brauer, Dr Rohan Grimley, Dr Kathryn Hayward
Co-Investigator(s):	Mrs Katrina Walker, Mrs Donna Rowley, Mrs Janelle Trinder, Mrs Suzanne McGufficke, Mrs Alana Campbell, Mrs Samantha Robertson
School(s):	SHRS, Division of Physiotherapy
Approval Number:	2014000371
Granting Agency/Degree:	Health Practitioner Research Research Grant Scheme 2014-2015; Wishlist Research Grant 2013, Sunshine Coast Health Foundation; Acute Stroke Unit
Duration:	1st November 2017

Comments/Conditions:

Expedited review on the basis of approval from the Metro North HHS HREC (PCH) dated 05/03/2014

Note: if this approval is for amendments to an already approved protocol for which a UQ Clinical Trials Protection/Insurance Form was originally submitted, then the researchers must directly notify the UQ Insurance Office of any changes to that Form and Participant Information Sheets & Consent Forms as a result of the amendments, before action.

Name of responsible Committee:
Medical Research Ethics Committee
This project complies with the provisions contained in the *National Statement on Ethical Conduct in Human Research* and complies with the regulations governing experimentation on humans.

Name of Ethics Committee representative:
Professor Bill Vicenzino
Chairperson
Medical Research Ethics Committee

Signature _____ Date 21.3.2014

Appendix 3 Public Health Act approval

Queensland Government

Department of Health

Enquiries to: Vanessa Druett
Health and Medical Research
Preventive Health Unit
Telephone: (07) 3328 9866
Ref QCOS13635/RD005002

Mrs Ingrid Rosbergen
Acute Stroke Unit 3FW
Nambour General Hospital
Hospital Road
NAMBOUR QLD 4560

Dear Mrs Rosbergen

Research Title: **Phase I Trial: Feasibility of creating an enriched environment and subsequent impact on activity levels for stroke patients in an Acute Stroke Unit.**
HREC Number: **HREC/14/QPCH/21**

I am writing to inform you that your request for access to confidential health information for the above project has been approved under the delegation of the Director-General. In accordance with Section 284 of the *Public Health Act 2005* the researchers listed in your application, dated 16 June 2014 can access and use the specified confidential information, providing they act within the limits detailed in your submission.

This approval (RD005002) commences on the date of this letter and is valid to 05 March 2017.

This approval relates to data from the Nambour General Hospital for the period from 23 June 2014 to 30 June 2015.

This approval means that you must undertake the responsibilities and obligations of confidentiality of the information under the provisions of the *Public Health Act 2005*. You must take all reasonable steps necessary to ensure that the confidential information is kept confidential, including storing or disposing of all data, information, documents and associated correspondence in a secure manner. Unauthorised use or disclosure of confidential information may incur a penalty under the laws of the Queensland Government. These obligations include providing notification of any change in the names of persons who will be given the information for the research.

When conducting research within the Queensland public health system, a copy of this Approval Letter must be provided to the relevant Research Governance Officer as part of your research governance application.

Please display this letter and a copy of your application when requesting the confidential information from the relevant data custodian.

Office
Department of Health
Level 2
15 Butterfield Street
Herston QLD 4006

Postal
HMR – Level 2
PO Box 2368
Fortitude Valley BC QLD 4006

Phone
61 7 3328 9866

Fax
61 7 3328 9115

You are required to provide an annual progress report and a final report at the completion of your project, to Health and Medical Research, Preventive Health Unit. Templates can be found on the web page http://www.health.qld.gov.au/ohmr/html/regu/aces_conf_hth_info.asp

Should you wish to extend your research project beyond this time or amend the study protocol, you will need to seek approval of these amendments from the approving HREC and re-apply for approval of the release of confidential data. This includes disclosing this information to and recruiting additional people to this project. Please provide a copy of your HREC approval of the amendments when re-applying.

Please feel free to contact Health and Medical Research, Preventive Health Unit on email HMR@health.qld.gov.au or phone 07 3328 9866 if you have any queries on this matter.

Yours sincerely

Kaye Pulsford
Senior Director, Preventive Health Unit
Chief Health Officer Branch
Health Services and Clinical Innovation Division

1/7/2014

Appendix 4 URL links to published papers

Chapter 3: The effect of an enriched environment on activity levels in people with stroke in an acute stroke unit: Protocol for a before - after pilot study

URL: https://pilotfeasibilitystudies.biomedcentral.com/articles/10.1186/s40814-016-0081-z

Chapter 4: Embedding an enriched environment in an Acute Stroke Unit increases activity in people with stroke: A controlled before-after pilot study.

URL: http://journals.sagepub.com/doi/10.1177/0269215517705181

Chapter 5: Embedding an enriched environment in an Acute Stroke Unit increases activity in people with stroke: A controlled before-after pilot study.

URL: http://journals.sagepub.com/doi/10.1177/0269215517705181

Chapter 7: A qualitative investigation of the perceptions and experiences of nursing and allied health professionals involved in the implementation of an enriched environment in an Australian acute stroke unit.

URL: http://bmjopen.bmj.com/content/7/12/e018226

Appendix 5 Participant Information and Consent Form Stroke Survivor

Participant Information Sheet

HREC No: HREC/14/QPCH/21

Project Title:
Phase I trial: Feasibility of creating an enriched environment and subsequent impact on activity levels for stroke patients in an Acute Stroke Unit.

Name of researchers:
Mrs. Ingrid Rosbergen
Senior Physiotherapist, Nambour General Hospital, Queensland Health and MPhil Student University of Queensland
Prof. Sandy Brauer
School of Health and Rehabilitation Sciences, University of Queensland
Dr. Rohan Grimley
Senior Medical Officer, Nambour General Hospital, Queensland Health
Dr. Kathryn Hayward
School of Health and Rehabilitation Sciences, University of Queensland

You are invited to take part in this research project because you have had a stroke. *This research project is studying the effect the environment has on activity levels for stroke clients in an Acute Stroke Unit.*

This Participant Information contains detailed information about the research project. Its purpose is to explain to you as openly and clearly as possible all the procedures involved in this project before you decide whether or not to take part in it.

Please read this Participant Information carefully. Feel free to ask questions about any information in this document. You may also wish to discuss the project with a relative or friend or your local doctor. Feel free to take adequate time for this. Your participation in this study is voluntary. You will receive the best possible care whether or not you take part.

Once you understand what the project is about, and if you agree to take part in it, you will be asked to sign the Consent Form. By signing the Consent Form, you indicate that you understand the information and that you give your consent to participate in the research project, consent to the procedures and assessments described, and consent to use your personal and health information as described. You will be given a copy of this Participant Information and Consent Form to keep as a record.

Purpose and background:

Previous experience has shown that stroke clients who are managed in an organized Stroke Unit have improved functional outcomes when compared to those who are managed on a general ward. One of the reasons for these improved outcomes is the ability to commence early rehabilitation. Higher intensity treatment has shown better functional outcomes in clients recovering from stroke. However, what the ideal time of onset and optimal intensity for early rehabilitation is, is still unknown.

This study aims to determine the effect of an alternative model of early rehabilitation following stroke. The aims of this study are:

1. To study the effect of activity levels on recovery post stroke.
2. To study the effect activity levels have on complications post stroke.
3. To study if the amount of activity post stroke results in a reduction in disability.
4. To study the effect the environment has on the activity level of clients post stroke.

This study also aims to determine whether an alternative model of early rehabilitation is feasible in the Stroke Unit setting and whether this may contribute to enhancing efficacy of acute stroke client care. This alternative model of early rehabilitation, if deemed effective, could be applied to other Stroke Units.

Procedures:

After you have consented to participate in this study, a member of the research team will assess:

1. Medical and social history,
2. Physical assessment to determine your current level of functioning,
3. Current weight, nutritional requirements and intake.
4. Mood and anxiety levels via questionnaire.

The project involves comparing a group of patients treated with a new model of rehabilitation, to a group with patients treated with the traditional model of rehabilitation for acute stroke clients in Australia.

After the initial questions and assessment you will commence your rehabilitation with the nurses and allied health staff at the hospital. The type of rehabilitation you will receive will be dependent on which group you are in. We cannot tell you which group you are in during the study as this could influence the results of the study. During your hospital stay you will receive one of these types of rehabilitation aimed at helping you recover your ability to move, communicate and to perform everyday functional tasks. The study length will be until you are discharged from the Acute Stroke Unit.

During your rehabilitation we will observe you over two weekdays and one weekend day, in 10-minute intervals from 7.30am to 7.30pm until you are discharged from the Acute Stroke Unit. We will observe where you are located, what you are doing at that point in time, if you need assistance with your activity and whether other persons are present. If the researcher is unable to clearly view you, the researcher may ask you what activity you are doing. These objective, recorded observations will give us information about the amount and type of activities clients are undertaking.

During your time in the Acute Stroke Unit, staff will observe and record what you have been eating every day. Some small physical assessments test will be performed at day 7, 14, 21 etc. depending on how long you are in the Stroke Unit.

On your day of discharge from the Acute Stroke Unit a person who is involved in the study will reassess:

1. Physical reassessments to determine your current level of functioning,
2. Current weight,
3. Mood and anxiety levels via questionnaire.

In addition you and your main carer will also be asked to complete a short survey regarding the treatment you received in the Acute Stroke Unit.

At three months after your stroke, someone involved in the study will contact you and your main carer by phone, to ask questions about your health and level of functioning in the time since your stroke. This telephone interview should take about 15 minute.

Alternatives to Participation

Your participation in this research is voluntary. If you choose not to provide your consent to participate in this study, then you will receive usual stroke unit care.

Possible benefits

We cannot guarantee or promise that you will receive any direct benefit from your participation in this research. However you will be assisting us to gather information that may improve stroke care and provide better outcomes for stroke survivors.

Possible risks

With any form of physical rehabilitation there are possible risks and discomforts. A possible discomfort of rehabilitation is tiredness, as rehabilitation encourages you to spend time engaged in activities. You will be asked how you are feeling during treatment sessions and the session will be adjusted to your ability.
After a stroke, any movement in an upright position may result in a fall in blood pressure, making you feel faint or clammy. This could also result in a fall. Your blood pressure will be carefully monitored to minimize this risk. If your blood pressure or temperature is not within normal limits your activity will be adjusted.
You are free to withdraw your participation from the project at any time should you wish to, or should you experience any distress.

Confidentiality and Privacy

The research team will retain sufficient information about you in order to contact you should the need arise. This information is maintained in a secure and confidential manner. Any information that is obtained in this study will remain confidential and will only be disclosed with your permission, except if required by law.

For the purpose of this study you will be identifiable by a trial number.
No data collected will be linked or associated with any of your personal details. After the study is finished, any paper records and electronic data will be kept for a minimum of at least 7 years in accordance with the NHMRC guidelines until its confidential destruction. If you give us permission by signing the consent form, we plan to publish the results in international scientific journals. Your identity will not be disclosed in any publication or presentation.
The research team will maintain confidentiality of your medical records. An authorized representative of the trial, or the Ethics Committee of the hospital may inspect your medical records that relate to this study. All records assessed will be kept strictly confidential. Consent to participate in the study includes consent to these inspections.

If you experience any problems or have any questions or concerns during the study, you can contact the research staff on the telephone number provided. At your request, we can discuss your personal results with you and provide a summary of the overall results and conclusions at the completion of the study. You can also be directed to any publications arising from this research.

Withdrawal from the research

Your participation in this research is voluntary. If you wishes to withdraw consent, the Principal Investigator Mrs. Ingrid Rosbergen, should be contacted within 24 hours. At this time you will sign the revocation of consent form. Withdrawal from this study will not affect your relationship with your treating team or your access to high quality treatment and stroke unit care.

Complaints

If you suffer any injuries or complications as a result of this research project, you should contact the study team as soon as possible and you will be assisted with arranging appropriate medical treatment. All medical treatment required to treat the injury or complication will be free of charge as a public patient in any Australian public hospital.

If you wish to make a confidential complaint, which will be investigated independently of the hospital please contact Health Quality and Complaints Commission Phone 07- 31205999. Free call 1800 077 308 (outside Brisbane) or email info@hqcc.qld.gov.au

Organization of Research and Funding
This study is a partnership between researchers at the Nambour General Hospital and the School of Health and Rehabilitation Sciences, at the University of Queensland. Mrs. Ingrid Rosbergen, physiotherapist and MPhil student, is leading this research project. You will not be reimbursed for participating in this research project.

Ethics Approval

All research in Australia involving humans is reviewed by an independent group of people called a Human Research Ethics Committee (HREC). This study has been reviewed and approved by The Prince Charles Hospital, Metro North Hospital and Health Service, Human Research Ethics Committee. Should you wish to discuss any aspects of the study with someone not directly involved, you may contact the Chairperson of The Prince Charles Hospital, Human Research Ethics Committee on 07- 31394500 responsible for reviewing research.

Further Information and Contacts
We would like to thank you for your interest in the research titled:
Phase I trial: Feasibility of creating an enriched environment and subsequent impact on activity levels for stroke patients in an Acute Stroke Unit. If you would like more information about the study or if you wish to discuss any other concerns, please feel free to contact Mrs. Ingrid Rosbergen Phone 07-53703018 or email; ingrid.rosbergen@health.qld.gov.au

Participant Consent Form

HREC No:	HREC/14/QPCH/21
Project Title:	Phase I trial: Feasibility of creating an enriched environment and subsequent impact on activity levels for stroke patients in an Acute Stroke Unit
Name of Researchers:	Mrs. Ingrid Rosbergen Prof. Sandy Brauer Dr. Rohan Grimley Dr. Kathryn Hayward

I, _____ agree to participate in the above named research study and understand that I:

Stroke survivor

- ☐ Agree to be monitored and observed during my stay in the Acute Stroke Unit
- ☐ Agree to be physically assessed, participate with questionnaires and to be interviewed at 3 months post stroke
- ☐ Agree to have my main carer contacted about participating in this research

- I have been informed as to the nature and extent of any risk to my health or well-being.
- I am aware that, although the project is directed to the expansion of medical knowledge generally, it may not result in any direct benefit to me.
- I have been informed that my refusal to consent to participate in the study will not affect in any way the quality of treatment provided to me.
- I have been informed that I may withdraw from the project at my request at any time and that this decision will not affect in any way the quality of treatment.
- I will be given a copy of the Participant Information and Consent Form to keep.
- I have been advised that the Chief Executive, Nambour General Hospital, on recommendation from The Prince Charles Hospital, Metro North Hospital and Health Service Human Research Ethics Committee has given approval for this project to proceed.
- I am aware that I may request further information about the project as it proceeds.
- I understand that, in respect of any information obtained during the course of the project; confidentiality will be maintained to the same extent as for my Hospital medical records. In the event of any results of the project being published, I will not be identified in any way.
- I agree that, if necessary, my medical records (in respect of my involvement in this project) may be inspected by a Research Assessor. This assessor may be external to but approved by the Hospital,

provided that the Assessor does not identify me or my hospital's medical records in any way to a third party.

Patient's name: .....

Signature: ..... **Date:**
DD / MMM / YYYY

Name of Investigator: .....

Signature: ..... **Date:**
DD / MMM / YYYY

Revocation of Consent Form – Participant

HREC No:	HREC/14/QPCH/21
Project Title:	Phase I trial: Feasibility of creating an enriched environment and subsequent impact on activity levels for stroke patients in an Acute Stroke Unit
Name of Researchers:	Mrs. Ingrid Rosbergen Prof. Sandy Brauer Dr. Rohan Grimley Dr. Kathryn Hayward

- I hereby wish to WITHDRAW my consent to participate in the research project described above and understand that such withdrawal WILL NOT jeopardise any treatment or my relationship with Nambour General Hospital or the University of Queensland.

Participant's name (please print):

.....

(Signature) ..... Date:
DD / MM / YYYY

This Revocation of Consent should be forwarded to:

Mrs. Ingrid Rosbergen (Physiotherapist)
Allied Health Department
Nambour General Hospital
Nambour, Qld
4560

Appendix 6 Participant Information and Consent Form Substitute Decision Maker

Substitute Decision Maker Information Sheet

HREC No: HREC/14/QPCH/21

Project Title:
Phase I trial: Feasibility of creating an enriched environment and subsequent impact on activity levels for stroke patients in an Acute Stroke Unit.

Name of researchers:
Mrs. Ingrid Rosbergen
Senior Physiotherapist, Nambour General Hospital, Queensland Health and MPhil Student University of Queensland
Prof. Sandy Brauer
School of Health and Rehabilitation Sciences, University of Queensland
Dr. Rohan Grimley
Senior Medical Officer, Nambour General Hospital, Queensland Health
Dr. Kathryn Hayward
School of Health and Rehabilitation Sciences, University of Queensland

As the substitute decision maker for the patient, you are invited to consider their participation in this research project. *This research project is studying the effect the environment has on activity levels for stroke clients in an Acute Stroke Unit.*

This Information Sheet contains detailed information about the research project. Its purpose is to explain to you as openly and clearly as possible all the procedures involved in this project before you decide whether or not to consent to the patient taking part.

Please read this Information Sheet carefully. Feel free to ask questions about any information in this document. You may also wish to discuss the project with a relative or friend or your local doctor. Feel free to take adequate time for this. The patient's participation in this study is voluntary. The patient will receive the best possible care whether or not the patient will take part.

Once you understand what the project is about, and if you agree to the patient's participation, you will be asked to sign the Consent Form. By signing the Consent Form, you indicate that you understand the information and that you give your consent for the patient to take part in the research project, consent to the procedures and assessments described, and consent to the patient's personal and health information being used as described. You will be given a copy of this Substitute Decision Maker Information and Consent Form to keep as a record.

Purpose and background:

Previous experience has shown that stroke clients who are managed in an organized Stroke Unit have improved functional outcomes when compared to those who are managed on a general ward. One of the reasons for these improved outcomes is the ability to commence early rehabilitation. Higher intensity treatment has shown better functional outcomes in clients recovering from stroke. However, what the ideal time of onset and optimal intensity for early rehabilitation is, is still unknown.

This study aims to determine the effect of an alternative model of early rehabilitation following stroke.

The aims of this study are:

5. To study the effect of activity levels on recovery post stroke.
6. To study the effect activity levels have on complications post stroke.
7. To study if the amount of activity post stroke results in a reduction in disability.
8. To study the effect the environment has on the activity level of clients post stroke.

This study also aims to determine whether an alternative model of early rehabilitation is feasible in the Stroke Unit setting and whether this may contribute to enhancing efficacy of acute stroke client care. This alternative model of early rehabilitation, if deemed effective, could be applied to other Stroke Units.

Procedures:

After you have consented for the patient to participate in this study, a member of the research team will assess the patient's:

5. Medical and social history,
6. Physical assessment to determine their current level of functioning,
7. Current weight, nutritional requirements and intake.
8. Mood and anxiety levels via questionnaire.

The project involves comparing a group of patients treated with a new model of rehabilitation, to a group with patients treated with the traditional model of rehabilitation for acute stroke clients in Australia.

After the initial questions and assessment the patient will commence their rehabilitation with the nurses and allied health staff at the hospital. The type of rehabilitation the patient will receive will be dependent on which group the patient is in. We cannot tell you which group the patient is in during the study as this could influence the results of the study. During the patient's hospital stay the patient will receive one of these types of rehabilitation aimed at helping the patient recover their ability to move, communicate and to perform everyday functional tasks. The study length will be until the patient is discharged from the Acute Stroke Unit.

During the patient's rehabilitation we will observe the patient over two weekdays and one weekend day, in 10-minute intervals from 7.30am to 7.30pm until the patient is discharged from the Acute Stroke Unit. We will observe where the patient is located, what the patient is doing at that point in time, if the patient needs assistance with their activity and whether other persons are present. If the researcher is unable to clearly view the patient, the researcher may ask the patient what activity the patient is doing. These objective, recorded observations will give us information about the amount and type of activities clients are undertaking.

During the patient's time in the Acute Stroke Unit staff will observe and record what the patient has been eating every day. Some small physical assessments test will be performed at day 7, 14, 21 etc. depending on how long the patient will be in the Stroke Unit.

On the patient's day of discharge from the Acute Stroke Unit a person who is involved in the study will reassess:

4. Physical reassessments to determine the patient's current level of functioning,
5. Current weight,
6. Mood and anxiety levels via questionnaire.

In addition the patient and their main carer will also be asked to complete a short survey regarding the treatment the patient received in the Acute Stroke Unit.

At three months after the patient's stroke, someone involved in the study will contact the patient and the main carer by phone, to ask questions about their health and level of functioning in the time since the patient's stroke. This telephone interview should take about 15 minute.

Alternatives to Participation

The patient's participation in this research is voluntary. If you choose not to provide your consent for the patient to participate in this study, then the patient will receive usual stroke unit care.

Possible benefits

We cannot guarantee or promise that the patient will receive any direct benefit from their participation in this research. However the patient will be assisting us to gather information that may improve stroke care and provide better outcomes for stroke survivors.

Possible risks

With any form of physical rehabilitation there are possible risks and discomforts. A possible discomfort of rehabilitation is tiredness, as rehabilitation encourages the patient to spend time engaged in activities. The patient will be asked how they are feeling during treatment sessions and the session will be adjusted to the patient's ability.
After a stroke, any movement in an upright position may result in a fall in blood pressure, making the patient feel faint or clammy. This could also result in a fall. The patient's blood pressure will be carefully monitored to minimize this risk. If the patient's blood pressure or temperature is not within normal limits their activity will be adjusted.
You are free to withdraw your consent for the patient's participation from the project at any time should you wish to, or should you experience any distress.

Confidentiality and Privacy

The research team will retain sufficient information about the patient in order to contact them should the need arise. This information is maintained in a secure and confidential manner. Any information that is obtained in this study will remain confidential and will only be disclosed with your permission, except if required by law.

For the purpose of this study the patient will be identifiable by a trial number.
No data collected will be linked or associated with any of their personal details. After the study is finished, any paper records and electronic data will be kept for a minimum of at least 7 years in accordance with the NHMRC guidelines until its confidential destruction. If you give us permission by signing the consent form, we plan to publish the results in international scientific journals. The patient's identity will not be disclosed in any publication or presentation.
The research team will maintain confidentiality of the patient's medical records. An authorized representative of the trial, or the Ethics Committee of the hospital may inspect the patient's medical records that relate to this study. All records assessed will be kept strictly confidential. Consent to participate in the study includes consent to these inspections.

If you experience any problems or have any questions or concerns during the study, you can contact the research staff on the telephone number provided. At your request, we can discuss the patient's personal results with you and provide a summary of the overall results and conclusions at the completion of the study. You can also be directed to any publications arising from this research.

Withdrawal from the research

The patient's participation in this research is voluntary. If you wish, you are free to withdraw the patient from participation in the project at any stage. To withdraw your consent, the Principal Investigator Mrs. Ingrid Rosbergen, should be contacted within 24 hours. If you decide to withdraw the patient, you will sign the revocation of consent form. Withdrawal from this study will not affect

the patient's relationship with their treating team or their access to high quality treatment and stroke unit care.

Complaints

If the patient suffers any injuries or complications as a result of this research project, you should contact the study team as soon as possible and the patient will be assisted with arranging appropriate medical treatment. All medical treatment required to treat the injury or complication will be free of charge as a public patient in any Australian public hospital. If you wish to make a confidential complaint, which will be investigated independently of the hospital please contact Health Quality and Complaints Commission Phone 07- 31205999. Free call 1800 077 308 (outside Brisbane) or email info@hqcc.qld.gov.au

Organization of Research and Funding
This study is a partnership between researchers at the Nambour General Hospital and the School of Health and Rehabilitation Sciences, at the University of Queensland. Mrs. Ingrid Rosbergen, physiotherapist and MPhil student, is leading this research project. The patient will not be reimbursed for participating in this research project.

Ethics Approval

All research in Australia involving humans is reviewed by an independent group of people called a Human Research Ethics Committee (HREC). This study has been reviewed and approved by The Prince Charles Hospital Metro North Hospital and Health Service Human Research Ethics Committee. Should you wish to discuss any aspects of the study with someone not directly involved, you may contact the Chairperson of The Prince Charles Hospital, Human Research Ethics Committee on Phone 07-31394500 responsible for reviewing research.

Further Information and Contacts
We would like to thank you for your interest in the research titled:
Phase I trial: Feasibility of creating an enriched environment and subsequent impact on activity levels for stroke patients in an Acute Stroke Unit. If you would like more information about the study or if you wish to discuss any other concerns, please feel free to contact Mrs. Ingrid Rosbergen
Phone 07- 53703018 or email; ingrid.rosbergen@health.qld.gov.au

Substitute Decision Maker Consent Form

HREC No:	HREC/14/QPCH/21
Project Title:	Phase I trial: Feasibility of creating an enriched environment and subsequent impact on activity levels for stroke patients in an Acute Stroke Unit
Name of Researchers:	Mrs. Ingrid Rosbergen Prof. Sandy Brauer Dr. Rohan Grimley Dr. Kathryn Hayward

I, _____ am the person responsible for _____

I consent to the participation of _____ in the above named research study, according to the conditions in the Substitute Decision Maker Information Sheet and understand that I

- ☐ Agree for the patient to be monitored and observed during their stay in the Acute Stroke Unit
- ☐ Agree for the patient to be physically assessed, to participate with questionnaires and to be interviewed at 3 months post stroke
- ☐ Agree that the patient's main carer is contacted about participating in this research

- I have been informed as to the nature and extent of any risk to the patient's health or well-being.
- I am aware that, although the project is directed to the expansion of medical knowledge generally, it may not result in any direct benefit to the patient.
- I have been informed that my refusal to consent for the patient to participate in the study will not affect in any way the quality of treatment provided to the patient.
- I have been informed that I may withdraw the patient from the project at my request at any time and that this decision will not affect in any way the quality of treatment for the patient.
- I will be given a copy of the Substitute Decision Maker Information and Consent Form to keep.
- I have been advised that the Chief Executive, Nambour General Hospital, on recommendation from The Prince Charles Hospital Metro North Hospital and Health Service Human Research Ethics Committee has given approval for this project to proceed.
- I am aware that I may request further information about the project as it proceeds.
- I understand that, in respect of any information obtained during the course of the project; confidentiality will be maintained to the same extent as for the patient's Hospital medical records. In the event of any results of the project being published, the patient will not be identified in any way.
- I agree that, if necessary, the patient's medical records (in respect of the patient's involvement in this project) may be inspected by a Research Assessor. This assessor may be external to but

approved by the Hospital, provided that the Assessor does not identify the patient or the patient's hospital's medical records in any way to a third party.

Substitute Decisions maker's name: .....

Signature: ..... **Date:**
DD / MMM / YYYY

Name of Investigator: .....

Signature: ..... **Date:**
DD / MMM / YYYY

Revocation of Consent Form
Substitute Decision Maker

HREC No:	HREC/14/QPCH/21
Project Title:	Phase I trial: Feasibility of creating an enriched environment and subsequent impact on activity levels for stroke patients in an Acute Stroke Unit
Name of Researchers:	Mrs. Ingrid Rosbergen Prof. Sandy Brauer Dr. Rohan Grimley Dr. Kathryn Hayward

- I hereby wish to WITHDRAW my consent for _____ to participate in the research project described above and understand that such withdrawal WILL NOT jeopardise their treatment or their relationship with Nambour General Hospital or the University of Queensland.

Substitute Decision Maker's name (please print):

.....

(Signature) ..... Date:
DD / MM / YYYY

This Revocation of Consent should be forwarded to:

Mrs. Ingrid Rosbergen (Physiotherapist)
Allied Health Department
Nambour General Hospital
Nambour, Qld
4560

Appendix 7 Enriched Environment Intervention Protocol

Enriched Environment in the Acute Stroke Unit and subsequent Impact on activity levels (EESI Trial)

Enriched Environment Intervention Protocol to stimulate physical, cognitive and social activity

AIMS: To describe the different aspects of the Enriched Environment intervention and to provide structure to the execution of the intervention block of the EESI trial.
The protocol should provide detailed and structured information to all staff members who are working in the Acute Stroke Unit and describes the responsibilities for staff members.

The Enriched Environment intervention has the following aspects:

1. Stimulating physical, social and cognitive environment to enhance activity
2. Change in staff focus to facilitate activity and expand scope of practise of staff to increase opportunities of enhancing patient activity
3. Patient and family involvement in their own stroke journey and recovery after stroke.

The Enriched Environment:

1. Has a week schedule/ program. Depending on patients and staff aspects the week schedule is flexible for change.
2. Will aim to schedule three hours of communal activities per day
3. Patients need a safe Blood Pressure and Temperature measurement when participating in an activity. During the day 4 observations of blood pressure and temperature will be undertaken. BP should not be above 200 systolic and temperature not above 38 degrees before an activity. If the blood pressure or temperature is to high the following activity period will be missed till values are within normal range.
4. All staff will encourage rest time for patients from 13.00 till 14.00

Staff involved in the Enriched Environment:
Nursing staff divided in Clinical Nurse Coordinator (CNC)/ Clinical Coach/ Clinical Nurse/ Registered Nurse (RN)/ Enrolled Nurse (EEN)/ Assistant in Nursing (AIN).
Allied Health Staff: Physiotherapist, Occupational Therapist, Speech Therapist, Dietician, Social Worker
Allied Health Assistants (AHA)
Operational staff: wards men, kitchen personnel
Medical staff/ doctors

Optional others: volunteers/ stroke survivors/ chaplain depending on availability

STIMULATING PHYSICAL, SOCIAL AND COGNITIVE ENVIRONMENT TO ENHANCE ACTIVITY

The physical environment of the Acute Stroke Unit will be altered to facilitate activity. A stimulating environment can enhance patient activity. A day structure will give direction to patient activity.

MEAL TIMES

Interactive mealtimes will provide opportunities for patients to increase physical and social activities. Patients will be scheduled to participate in breakfast and lunch times sessions on the week schedule board. The patient will be mobilized to the therapy room and during the meal session nutritional intake, ADL and social activities will be encouraged. The normal hospital meal trays will be used providing each patient with the correct meal texture and diet.
The kitchen staff will put the meal tray of the participating patients on the table in the therapy room. The staff members who supervise the meal session are responsible for providing the correct tray to the patients.

Breakfast sessions:
Tuesday/Wednesday/Thursday from 7.15 till 8.00
Lunch sessions:
Every weekday from 12.00 till 12.45

There will be a maximum of 4 patients for 2 staff members during mealtimes. If more patients are suitable for attending a meal session there should be at least 1 staff member for each 2 patients available. Wheelchairs will be available for patients to support patient transport. Patients who are able to walk with one-person assist will be mobilized to the meal with assistance.

Staff involved:

The night staff will be responsible for room preparation for the breakfast session in the therapy room. The tables and chairs are in the correct position. All staff will be informed to make sure the therapy gym is tidy and ready for use for all sessions.
Breakfast
Physiotherapist or occupational therapist/ wards men and Allied Health Assistants will mobilize patients to and from the breakfast sessions. Nursing staff are encouraged to help when able.
During the breakfast session the Allied Health Assistant and physiotherapist or occupational therapist are present. (Other therapy staff can be present if required)
Physiotherapists or occupational therapist and Allied Health Assistants will mobilize patient back to their room after breakfast.
Lunch
Physiotherapists and Allied Health Assistants will mobilize patients to the lunch sessions. Nursing staff are encouraged to help when able.
During the lunch session the Allied Health Assistant and AIN float will be present. After the lunch session the patient will be mobilized back to their room and toileted by nursing staff and wards men. Patients will be encouraged to have rest time from 13.00 till 14.00.

COMMUNAL AREA

Communal areas will be created in three locations in the Acute Stroke Unit for patient to sit and to be active. In the communal areas there is access to books/ magazines/ games and newspapers.

Family and visitors will be encouraged to spend time with the patient in the communal areas. When a patient is sitting in a communal area the patient has access to a bell to alert staff if needed. Communal spaces will be used to enhance social, cognitive and physical activities.

Staff involved:
All staff members will encourage and facilitate patients to spent time in a communal area.
The nursing champions will specifically direct other nursing staff to facilitate patients to utilize the communal areas. Allied health staff will direct allied health assistants to stimulate activity in the communal areas.

GROUP SESSIONS
Group sessions will be organized daily to stimulate activity and to optimise therapy time. There will be a maximum of 4 patients for 2 staff members during group sessions. If more patients are suitable for a group session there should be at least 1 staff member for each 2 patients available.
Wheelchairs will be available for patients to support patient transport. Patients who are able to walk with one-person assist will be mobilized to the group session with assistance.

Monday, Tuesday, Thursday and Friday afternoon from 14.30 till 15.30
Wednesday morning from 10.45 till 12.00.
The group sessions will be divided in different themes.
1. Monday 14.30: upper limb & balance/ walking group / endurance/ balance board Wii (PT)
2. Tuesday 14.30: life style education/ emotional support group/ stroke education with (outdoor) afternoon tea (CNC, SW, DIET)
3. Wednesday 10.45: communication session by speech therapists (SP)
4. Thursday 14.30: upper limb & balance training/ cognitive training / Wii games (OT)
5. Friday 14.30: upper limb & balance/ walking group / endurance/ balance board Wii (PT)
This is a flexible week schedule. The expectation is that if a discipline is unable to provide the group session due to unexpected leave, that working allied health members/ AHA that day will take over the group session.

Staff Involved:
1. Physiotherapy will organize the Monday and Friday group session.
2. Social work/ CNC and/ or dietician will organize the Tuesday group session
3. Speech therapists will organize the Wednesday group session
4. Occupational Therapy will organize the Thursday group session
Allied Health Assistants and Nursing staff will be asked to mobilize patients to and from group sessions.

PATIENT BEDSIDE AREA
Different strategies will be utilized to create a patient bedside area that will stimulate patient activity outside therapy hours.
1. We encourage families to bring the patients own clothes and toiletries to the hospital. Families will also be encouraged to bring photos and hobby activities for the patient to the hospital.
2. A box with laminated activity cards will be available on the Acute Stroke Unit. A patient will have at least 5 Activity Cards on the wall opposite their bed with the described activities.

3. The patient will receive a bag with an iPad and headphones, a communication book and activity cards target sheet for the duration of their stay in the Acute Stroke Unit. The iPad has therapy apps, games, books, music and other apps.
4. There will be an activity trolley on the ward and the patient can choose if they would like to use some of the equipment on the trolley at the bedside or in communal areas at a daily basis. (E.g. magazines, newspapers, puzzles etc.)

Staff involved:
1. The patient and family will receive a brochure from a research team member with information how to promote their own recovery. In this brochure the family is asked to bring in the patient clothes/ toiletries/ photos and hobby activities and the day structure is explained
2. The AHA will explain the iPad use to the patient and family and will set up the charger. The AHA will explain to the patient and family that the devices are set up with a tracking system and that patients and families are encouraged to put the devices away in the second drawer of the bedside cabinet for storage.
The patient and their family are not responsible for loss or theft involving the devices.
3. The activity trolley will be located in the therapy room and the nursing staff will encourage the patient to do an activity between 6.00pm and 8.00 pm
3. Allied Health Therapists will choose activity cards for the patients and will put the cards on the wall. The therapist will explain the target log sheet and requested repetition number. Each card will explain the activity and the targets will be written on the target log sheet. The patient and family are encouraged to do the activity independently outside therapy hours.
Nursing staff will encourage and facilitate patient and family to execute the activity cards outside therapy hours and during weekend days.

STAFF FOCUS TO FACILITATE ACTIVITY AND EXPAND SCOPE OF STAFF TO ENHANCE ACTIVITY

Staff will play an important role in the Enriched Environment. All staff members in the Acute Stroke Unit need to adhere to the EESI intervention protocol. To be able to achieve change to a new model of care there are many theoretical models available to guide this process. Staff members will need to be aware of the results of increased activity in recovery after stroke to be able to contemplate, act upon and adhere to the intervention protocol. Staff members should be very proud of their contribution to patient recovery and need to be acknowledged if they provide extra activity to the patient. A relapse to the intervention protocol requires support from the whole team to keep staff motivated to continue with the change.

Team Education
The nursing staff spend by far the most time with the patients during the day. They will play a crucial role in the EESI intervention protocol to be successful.
During the six weeks between the two blocks nursing education time will be used to
1. Explain recovery after stroke and the need for the patient to be active to stimulate plasticity and recovery.
2. Explain the effect of inactivity on secondary complications, which may lead to increased death and disability after stroke.

3. The EESI intervention protocol will be explained in detail
4. Barriers and enablers will be discussed during each education session
5. Put emphasis on the important contribution of each staff member to the Enriched Environment.

The nursing education will expand during these months and EEN's, AIN's, AHA, allied health staff members and wards men will be invited to join the sessions to create a collaborative approach in the acute stroke unit.

Nurse champions
Nursing champions will be assigned to help with motivating and facilitating nursing staff to adhere to the EESI intervention protocol.
The nurse champions will have the following role:
1. They will be a role model for getting the patient and family involved in activity and to execute the protocol.
2. They will actively use identified enablers in difficult busy moments.
3. They will direct other nursing staff members to execute the intervention protocol.
4. They will provide positive feedback to staff when activity has been increased and adherence is demonstrated.
5. They will communicate to the research team if barriers have been identified

The NUM, CNC, team leader and the clinical coach will help facilitate and support all staff during the intervention. The research team and allied health members will play a very important role in positive reinforcement when staff is increasing activity with adherence to the protocol. Complimenting a staff member 'that the person is doing a great job and is making a big impact on a patient their recovery' is very powerful.
It should be emphasized to staff that the Enriched Environment should not increase the workload. It is about efficacy and good structure with utilizing all staff members to their full potential.

Expand scope of practice
Staff members will be asked to change routine practice when incorporating focus on increasing activity. Allied Health Assistants and Assistants in Nursing will be asked to spend time with patients and family when sitting in communal spaces and group sessions will also be included in their role. The allied health assistants in the Acute Stroke Unit will be trained to a 'generic' allied health assistant meaning they can assistant the occupational therapist, speech therapist and physiotherapist.

PATIENT AND FAMILY INVOLVEMENT

The patient and family can contribute to their own recovery. To provide the patient and family with self-control and self-efficacy, education regarding desired behaviours is crucial.

Patient and family will receive education regarding recovery after stroke and the need to be very active to reduce secondary complication and to facilitate plasticity after stroke. Repetitions are required to learn a task or activity and that patient and families are encouraged to adhere to the ward structure. The patient and family will receive a brochure about recovery after stroke and how the patient and family can contribute to enhance activity during admission in the Acute Stroke Unit.

The following aspects will be explained in the brochure:
1. That increasing activities in the acute stage after a stroke can result in better functional outcomes and fewer complications
2. The day structure and the different aspects of the day structure
3. Available equipment is explained
4. What the family can bring to facilitate activities

Staff Involved:
A research team member will provide and explain the brochure.
The Allied Health Assistant will be notified when a patient requires an iPad and will explain the equipment to the patient/ provide head phones/ bag and instruction about storage.
Allied Health professionals will select and explain activity cards on the first day of meeting with the patient in the Acute Stroke Unit. Each discipline will be taking responsibility for the start of self-directed exercise.

ACTIVITIES

Activity: a specific deed, action, function, or sphere of action

Physical activities: everyday/personal, athletic, recreational or occupational activities that require physical skills and utilize strength, power, endurance, speed, flexibility, range of motion or agility. Examples include: bed exercises, sitting unsupported, standing, transferring, walking, stairs, upper limb activity, dressing, toileting, showering, grooming, eating, drinking, upper limb management, other, no physical activity.

Social activities: any interaction, which involves verbal communication with people present or through telecommunication devices, and other non-verbal interactions such as touching, kissing or holding and participation with group activities.
Doing things together or interacting**.** This can take various forms: talking, laughing, touching, kissing, singing, telephone/mobile phone use, group communication, other, no social activity.

Cognitive activities: any non-physical leisure activity which involves the patient actively engaging in a mental task such as: reading, listening, crosswords, puzzles, games, writing, watching television, computer/ IPad use, crafts, finance management, playing a instrument, other, no cognitive activity.

CHARACTERISTICS OF THE WARD

Number of beds in the ward:
Total 16 beds
16 beds Acute Stroke and Geriatric patients. General Medical patients if Stroke or Geriatric patient numbers are low.

Nurse to patient ratio:
In the 16 beds Acute Stroke Unit: 6.2 hours per patient a day.

Number of fulltime allied health staff servicing the Stroke unit:

Physiotherapy 1.0 HP5/ 1.0 HP3
Occupational therapy 1.0 HP4/ 0.6 HP3
Speech Therapy 1.0 HP4
Social Worker 1.0 HP4
Dietician 0.5 HP3

Therapy assistants:

Physiotherapy assistant 0.3 FTE
Occupational therapy assistant: 0.1FTE
Speech therapy assistant: 0.3 FTE
Social work assistant: only performing administrative duties for 2 hours a week

Number of operational service officers (wards-people):

From 6.00 till 14.30 2.0FTE operational service officers are available.
After 14.30 there is a 1.0FTE shared operational service officer over 4 wards located on three different levels.

Arrangement of the rooms:

The unit is organized in a POD design system.
The Acute Stroke Unit has POD A and C. Each of these PODS has 6 allocated rooms, 4 single rooms and 2 double rooms so in total 8 beds.

General layout of the unit:

Communal spaces:
1. In front of the treatment room (gym) there is a small area for patient/ relatives to sit down. (2-4 chairs)
2. In front of the elevators there is a communal area for patients and relatives to sit down (4 chairs)
3. In front of the main reception desk is a communal area to sit down. (4 chairs)

The allied health therapy room (referred to as gym) is located on the ward and is 30 square meters. The room should not be used when no staff member is in this room.
An interview room is located in front of the main reception desk for family meetings, education or other purposes. It has 2 tables with 6 chairs and has a mobile computer unit. There is a doctor consult room for the stroke consultant with a desk, computer and treatment table.

Meetings and Policies:

Every morning at 8.30 there is a journey board meeting. The stroke journey board meeting is at POD A and takes 15 minutes.
Stroke Case conferences: Monday 8.30 till 9.00 and Wednesday 13.30 till 15.00
During rest time from 1.00pm till 2.00pm the lights are dimmed in the whole ward.

Characteristics of the patients:

On average around 8-16 patients are managed within the stroke team and 0-8 patients are managed within the geriatric team on the ward. If stroke and geriatric numbers are low general medical patients will get admitted to the ward.
The medical team responsible for the Acute Stroke Unit will admit stroke patients or patients with similar related problems like seizures, TIA, vestibular conditions, non- organic strokes and other undiagnosed neurological conditions

Appendix 8 Examples Activity Cards

EESI

Sit to Stand

- Have the bedside table in front of you (ask someone to put it there)
- Stand up and sit down using the armrests on your chair.

Document on the activity sheet

EESI

Physical exercises I: Lying in bed

- Shrug your shoulders (imagine the movement if not strong enough)
- Clasp your hands, lift your arms up till 90 degrees, bend you hands towards your head and straighten your arms up again.
- Move your wrists up and down gently.

Document on the activity sheet

EBSI

iPad

- Use the allocated application on iPad
- Read Book on the iPad
- Ask family and friends to help you – especially teenagers!

Document on the activity sheet

EBSI

Photos

- Enjoy a stroll down memory lane-ask your family to bring photos or a photo book (they can be photocopies).

- Create a wall display–create captions. Ask family and friends to record special moments and names.

Document on the activity sheet

Listen to Music

- Indulge in listening to soft / relaxing music for 30 minutes
- Try it twice a day

Document on the activity sheet

Exercise 6 – the bend and straighten

- Lift your arm and place your hand on your forehead (as in exercise 3 and 4)
- Hold your arm in place by your elbow if necessary
- Lift your hand up off your forehead (so your arm is straight if possible)
- Try to lower your palm back down to your forehead, as slowly as possible
- Repeat 3 X 20 reps

After stroke arm weakness is very common. The more exercise you can do the better chance you have of using your arm again in daily tasks.

Document on the activity sheet

Appendix 9 Patient Brochure

Equipment

Equipment is available to help increase your activities and staff will provide specific equipment for you to use

The activity trolley has equipment available to you and in the communal areas there are games, books, newspapers, and magazines

All equipment is property of the Acute Stroke Unit/ 3FW ward

What to bring

Could your family please bring the following to promote activity

Photo's or photo albums

Toiletries and easy clothing

Personal hobby activities like craft, puzzles, books, magazines etc

Questions?

Please ask our staff, we are here to assist you

Stroke Unit

Guide

Helping recovery

Information for patients and relatives

Encouraging Activity

Research has shown that when stroke patients increase their activity in the acute stage following a stroke, they have better functional outcomes and fewer complications.

This information brochure has been designed to help you and your family to promote recovery following your stroke and to provide information about

Day Structure

Breakfast

Tuesday/Wednesday/Thursday

7.15 till 8.00 in the therapy room

Lunch

Each weekday 12.00 till 12.45 in the therapy room

Group sessions

Each weekday there will be a group session. Group session times are on the therapy room door

Communal areas

We encourage you to use the communal areas on the ward. It will provide a change to your environment and facilitates interaction

Rest Times

1.00pm till 2.00pm

Activity cards

Activity cards will be on the wall at your bedside to inform you what activities are beneficial for your recovery

Family and staff can assist you with these activities

Please fill out the log sheet of performed daily activities

Appendix 10 Behavioural Mapping Protocol

Behavioral Mapping Protocol of Physical, Cognitive and Social Activity

Enriched Environment in the acute Stroke unit and subsequent Impact on activity levels

AIMS: To estimate what proportion a weekday and weekend day, stroke survivor's recovering within a typical Acute Stroke Unit, spend in physical, social and cognitive activities.

DEFINITIONS
Activity: a specific deed, action, function, or sphere of action

WHAT PATIENT IS DOING (TYPE OF ACTIVITY)

Physical activities: everyday/personal, athletic, recreational or occupational activities that require physical skills and utilize strength, power, endurance, speed, flexibility, range of motion or agility. Examples include: bed exercises, sitting unsupported, standing, transferring, walking, stairs, upper limb activity, dressing, toileting, showering, grooming, eating, drinking, upper limb management, other, no physical activity, unknown.

Social activities: any interaction, which involves verbal communication with people present or through telecommunication devices, and other non-verbal interactions such as touching, kissing or holding and participation in group activities.
Doing things together or interacting**.** This can take various forms: talking, laughing, touching, kissing, singing, telephone/mobile phone use, group communication, other, no social activity, unknown.

Cognitive activities: any non-physical leisure activity which involves the patient actively engaging in a mental task such as: reading, listening, crosswords, puzzles, games, writing, watching television, computer/ IPad use, crafts, finance management, playing a instrument, other, no cognitive activity, unknown.

Distinguishing between categories

Reading and writing: is to be categorised as a cognitive activity

Activities observed: there is the potential for the patient to be engaged in more than one category. For example, talking to nurse whilst writing a post card in unsupported sitting. The patient will be observed for 1 minute and the main activity will be recorded for each category. So each recording can result in one activity for each category. In this example: upper limb activity for physical, writing for cognitive, talking for social if these were the main activities during the 1-minute observation.

If though, on observation the patient is in a position or situation conducive to interaction (as per the definition of 'people present'), and no physical activity is observed, only social activity will be recorded.

ASSISTANCE

For each activity in a category the assistance level will be described.

Independent
Patient is performing the activity independent

Supervision
Patient is getting supervised during the activity

Assistance
Patient is getting 'hands on' assistance during the activity

Not applicable (NA)
When patient is not active in that category

LOCATION

Where in the hospital the patient is located (i.e. room or other site near the ward). The patient can only ever be in one location.

Bedside:
Within and around own room or bed

Ensuite bathroom:
Toilet, shower ensuite to patient's room

Therapy:
Therapy room/ gym

Communal areas:
Hallway/seating area in front of elevators/ seating area next to main reception desk/ seating area outside gym

Meeting rooms:
Doctors consult room/ interview room

Amenities:
Toilet on the ward

Off Stroke Unit:
Off ward for tests or other reasons/ outside

Offsite:
Attending tests at another facility/home visit/day leave

Other:

Unknown:

PATIENT POSITIONING

The patient can only be in one position.

Supine/ sitting in bed:
Patient is lying in bed or sitting up in bed

Sitting in regency chair
Patient is sitting in recliner chair/ tilt in space wheelchair

Sitting in chair/ wheelchair
Patient is sitting in normal chair with or without armrest or in wheelchair

Sitting unsupported:
Patient is sitting on edge of bed, or sitting with no back support

Standing:
Patient is in upright position

Other

Unknown

PEOPLE PRESENT

Who is with the patient. More specifically, 'people present' is defined by any person in the near vicinity of the patient, which is conducive to interaction. There is potential for more than one type of person to be with the patient and all are to be documented.

Exceptions to this rule:

- There are objects in-between the patient and the other person, which prevent or discourage interaction (i.e. curtains, large pieces of equipment).

Medical staff:
Doctor/s

Nursing staff:
Nursing staff/ nursing students/ diabetic and respiratory educator/ wound nurse
Operational Staff:
Wards men, cleaners, kitchen staff

Medical Imaging/ haematology:
Staff involved in medical imaging and haematology

Patients:
Patients within their own room and from elsewhere in the hospital.

Therapists and students:
Allied health therapists including: Physiotherapist, Social Worker, Occupational Therapist, Speech Therapist, Dieticians, Psychologists and allied health students.

Assistants:
Allied health assistants

Visitors:
Including patient's and or neighbouring patient's family and friends when within 2 meters distance.

Other:
Contractors or those non-specified

Alone:
No person/people in the near vicinity of the patient that is conducive to interaction.

Unknown

OTHER:
Epoch: for the purpose of this observational study, an epoch is defined as a ten minute time period.

PROCEDURE

The person responsible for the behavioural mapping will follow the route described as below during each epoch

Standardised route
At the commencement of each 10- minute observation period, the researcher will begin observations from room 1, designated as the START LOCATION. The researcher will then proceed to room 2,3,4, the seating area in front of the therapy room (gym), therapy room (gym), room 5,6, Pod A nursing desk, Clinical coach desk, room 11, 12, 13, 14, Pod C nursing desk, room 15,16, amenities, doctors consult room, main reception area, interview room, seating area in front of elevators END LOCATION. The researcher will complete the data using entry on the clinictivity iPad app or on the standardised observational spreadsheet for each patient as he/ she becomes

visible. The researcher will then back track along this same route completing data for patients who may have not been observed during the initial walkthrough.

Duration of each observation

During each 10- minute interval, the data for each patient will be based on an observation made by the researcher over one minute. The researcher will position themselves so that the patient can be easily seen (but at the same time taking steps to be inconspicuous) and will then note where they are, what their position is, the main activity for each category, the level of assistance for each category and whom they are with. The patient is recorded as performing one type of activity for each category (ie. physical, cognitive or social) at once. Once the researcher has noted all this information, data collection for this patient is complete and the researcher will move onto the next patient. Observations begin at the commencement of each 10- minute interval, ie. 7.30am, 7.40am, 7.50am, 8.00am etc.

Unobserved epochs

If the researcher is unable to either view or clearly view a patient during a 10- minute observation period, firstly, this observation should be clearly marked as unobserved. Then when clearly visible once more, the researcher is to either question the patient, staff or carer regarding where, who and what they themselves or the patient were doing. Activity estimates should err on the side of underestimating the activity.

If this information cannot easily or reliably be obtained, the patient should be marked as 'unobserved'.

SETTING

Mixed Acute Stroke Unit and Geriatric Department (16 beds)

TIME OBSERVED

2 Weekdays from 7.30 till 19.30 (total 12 hours)
1 Weekend day from 7.30 till 19.30 (total 12 hours)
N.B. Twelve hours was used in the Enriched Environment study but is not necessary to perform routinely. It is recommended that between seven and nine hours of behavioural mapping is performed to ensure estimations are representative of a typical day.

NUMBER OF OBSERVATIONS PER DAY

66

BREAKS

Over the period of 12 hours, 6 randomly chosen10- minutes breaks will be taken.

CHARACTERISTICS OF THE WARD

Number of beds in the ward:
Total 16 beds
16 beds Acute Stroke and Geriatric patients. General Medical patients if Stroke or Geriatric patient numbers are low.

Nurse to patient ratio:
In the 16 beds Acute Stroke Unit: 6.2 hours per patient a day.

Number of fulltime allied health staff servicing the Stroke unit:
Physiotherapy 1.0 HP5/ 1.0 HP3
Occupational therapy 1.0 HP4/ 0.6 HP3
Speech Therapy 1.0 HP4
Social Worker 1.0 HP4
Dietician 0.5 HP3
Therapy assistants:
Physiotherapy assistant 0.3 FTE
Occupational therapy assistant: 0.1FTE
Speech therapy assistant: 0.3 FTE
Social work assistant: only performing administrative duties for 2 hours a week

Number of operational service officers (wards-people):
From 6.00 till 14.30 2.0FTE operational service officers are available.
After 14.30 there is a 1.0FTE shared operational service officer over 4 wards located on three different levels.

Arrangement of the rooms:
The unit is organized in a POD design system.
The Acute Stroke Unit has POD A and C. Each of these PODS has 6 allocated rooms, 4 single rooms and 2 double rooms so in total 8 beds.

General layout of the unit:
Communal spaces:
1. In front of the treatment room (gym) there is a small area for patient/ relatives to sit down. (2-4 chairs)
2. In front of the elevators there is a communal area for patients and relatives to sit down (4 chairs)
3. In front of the main reception desk is a communal area to sit down. (4 chairs)
The allied health therapy room (referred to as gym) is located on the ward and is 30 square meters. The room should not be used when no staff member is in this room.
An interview room is located in front of the main reception desk for family meetings, education or other purposes. It has 2 tables with 6 chairs and has a mobile computer unit. There is a doctor consult room for the stroke consultant with a desk, computer and treatment table.

Meetings and Policies:
Every morning at 8.30 there is a journey board meeting. The stroke journey board meeting is at POD A and takes 15 minutes.
Stroke Case conferences: Monday 8.30 till 9.00 and Wednesday 13.30 till 15.00

During rest time from 1.00pm till 2.00pm the lights are dimmed in the whole ward.

Characteristics of the patients:
On average around 8-16 patients are managed within the stroke team and 0-8 patients are managed within the geriatric team on the ward. If stroke and geriatric numbers are low general medical patients will get admitted to the ward.
The medical team responsible for the Acute Stroke Unit will admit stroke patients or patients with similar related problems like seizures, TIA, vestibular conditions, non- organic strokes and other undiagnosed neurological conditions.

REFERENCES

Janssen H. Et al., An enriched environment increases activity in stroke patients undergoing rehabilitation in a mixed rehabilitation unit: a pilot non-randomized controlled trial. Disability and Rehabilitation; 2013: early online:1-8

Janssen H. Et al., Translating the use of an enriched environment poststroke from bench to bedside: study design and protocol used to test the feasibility of environmental enrichment on stroke patients in rehabilitation. Int. J Stroke. 2012;7(6):521-6

Janssen H. Et al., Physical, cognitive and social activity levels of stroke patients undergoing rehabilitation within a mixed rehabilitation unit. Clin Rehabil. 2012 Nov 28.

Miller RH, Keith RA. Behavioral mapping in a rehabilitation hospital. Rehailitation Psychology. 1973;20(4):148-55.

Mackey F, Ada L, Heard R, Adams R. Stroke rehabilitation: are highly structured units more conducive to physical activity than less structured units? Arch Phys Med Rehabil. 1996;77(10):1066-70.

Bernhardt J, Dewey H, Thrift A, Donnan G. Inactive and alone: physical activity within the first 14 days of acute stroke unit care. Stroke. 2004;35(4):1005-9.

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Behavioral Mapping Explanation of Physical, Cognitive and Social Activity

Enriched Environment in the acute Stroke unit and subsequent Impact on activity levels

This document aims to provide additional information to guide recording of observational data. Each category and corresponding sub-categories and definitions are outlined.

LOCATION:

1: Bedside: within and around own room
2: Ensuite bathroom: toilet, shower ensuite to patient's room
3: Therapy: therapy room/ gym
4: Communal areas: hallway/seating area in front of elevators, seating area next to main reception desk, seating area outside gym
5: Meeting rooms: doctors consult room/ interview room
6: Amenities: toilet on the ward and external to the patient's room
7: Off Stroke Unit: off ward for tests or other reasons/ outside
8: Off site: attending tests at another facility/home visit/ day leave
9: Other: location not mentioned above
10: Unknown

PATIENT POSITIONING

1: Supine/ sitting in bed: patient is lying in bed or sitting up in bed
2: Sitting in regency chair: patient is sitting in recliner/ regency/ fall out chair/ tilt in space shower chair/ tilt in space wheelchair or sling hoist
3: Sitting in chair/ wheelchair: patient is sitting in normal chair with or without armrest/ normal shower chair or in wheelchair
4: Sitting unsupported
5: Standing: patient is in upright position including standing hoist
6: Other: positioning not mentioned above
7: Unknown

PHYSICAL ACTIVITIES

1: Bed exercise: exercises lying down on bed like leg, trunk, rolling exercises
2: Sitting unsupported: up right sitting without back support, reaching out of base, forward lean, trunk exercises and other
3: Standing: patient is in upright position doing exercises like balance or step practice
4: Transferring: from bed to chair, shower chair or wheelchair. Transfer can be done with slide board, standing hoist, sling hoist and with pat slide.
5: Walking: all types of gait are included, like walking along rail, wall or space

6: Stairs: foot placement up or down steps, step on or off step, stairs
7: Upper limb activity: active range of motion exercises, grasp/ release, reaching, fine motor skills, object manipulation, pushing, donning collar by patient
8: Dressing: putting on/ off clothes, gown, pads, slippers, shoes etc.
9: Toileting: includes putting off/ on pants/ pads for toileting, cleaning, washing hands after toilet visit
10: Showering: the activity of washing under the shower or bath and drying
11: Grooming: care for teeth, hair, face, includes shaving and make up applying
12: Eating: opening tubs, cutlery use, eating, wiping mouth
13: Drinking: drinking out of cup/ bottle/ straw includes preparing sugar and milk in coffee/ tea
14: Upper limb management: passive range of motion exercises, oedema management and upper limb positioning, application FES
15: Other: wheelchair driving, tilt table, Motomed use
16: No physical activity: patient is not involved in any task or is sleeping.
17: Unknown

SOCIAL ACTIVITIES

1: Talking: talking to others
2: Laughing: laughing together with others
3: Touching: touching with another person for a social purpose like holding hands, stroking, embracing
4: Kissing: kissing another person
5: Singing
6: Telephone/ mobile phone: use of a phone/ mobile phone and talking to another person on a telephone/ mobile phone
7: Group communication: when participating in an organized group setting
8: Other
9: No social activity
10: Unknown

COGNITIVE ACTIVITIES

1: Reading: books, computer, magazine, newspaper, exercise sheets
2: Listening: music, radio, IPod, audio books, to information/ education
3: Crosswords: making crosswords, Sudoku, word seeking
4: Puzzles: making jigsaw puzzles
5: Games: card games, board games
6: Writing: writing on paper, emails, social media messages and therapeutic communication devices
7. Watching television
8: Computer/ IPad use; computer use, online games
9: Crafts: knitting, painting, drawing, etc.
10: Finance management: organizing bills, money actions
11: Playing a musical Instrument
12: Other
13: No cognitive activity
14: Unknown

ASSISTANCE

1: Independent: is able to perform activity on her/ his own
2: Supervision: patient needs someone to be present to supervise/ prompt/ encourage/ guide etc. to perform activity
3: Assistance: patient requires 'hands on' assistance from another person to be able to perform activity
4: Not Applicable (NA): when patient is not active in that category

PEOPLE PRESENT

1: Doctor/s
2: Nursing staff: nursing staff/ nursing students/ diabetic and respiratory educator/ wound nurse
3: Operational Staff: wards men, cleaners, kitchen staff
4: Medical Imaging/ hematology: staff involved in medical imaging and hematology
5: Patients: patients within their room and from elsewhere in the hospital
6: Therapists and students: allied health therapists including Physiotherapist, Social Worker, Occupational Therapist, Speech Therapist, Dieticians, Psychologists and allied health students
7: Assistants: allied health assistants
8: Visitors: including patient's and or neighbouring patient's family and friends when within 2 meters distance
9: Other: contractors or those non- specified
10: Alone: no person/ people in the near vicinity of the patient that is conducive to interaction
11: Unknown

Appendix 11 Adverse and Serious Adverse Event Forms, Results Adverse Events

ADVERSE EVENT FORM

Patient Number ☐☐☐☐

Adverse Event Types1. Falls 2. Pneumonia 3. Pressure areas 4. Cardiac problems 5. Seizures 6. Reduced GCS 7. Stroke 8. TIA 9. Urinary tract infection 10. Depression 11.Constipation 12. Malnutrition 13. Other

Has the participant had any Adverse Events during this study? ☐ Yes ☐ No (If yes please list Adverse Events below)

Severity	**Study Intervention Relationship**	**Action Taken Regarding Study Intervention**	**Outcome of AE**	**Serious**
1. Mild 2. Moderate 3. Severe	1. Definitely related 2. Possibly related 3. Not related	1. None 2. Discontinued temporarily 3. Discontinued permanently	1. Resolved, No sequelae 2. AE still present – no treatment 3. AE still present – being treated 4. Residual effects present – not treated 5. Residual effects present – treated 6. Death 7. Unknown	Yes No If yes complete Serious Adverse Event Form.

Adverse Event	Date	Severity	Relationship to Intervention	Action Taken	Outcome of AE	Serious Adverse Event

Severity:
Mild – the event causes awareness of signs or symptoms, but is easily tolerated, does not interfere with intervention
Moderate – the event causes the patient discomfort sufficient to cause interference with current level of activity, requires more frequent monitoring or diagnostic tests.
Severe – the event is incapacitating resulting in the patient not being able to do usual activity.
A **SAE** is an adverse event that: 1. led to death, 2. led to serious deterioration in health of a patient, user, or other that: a) Results in life threatening illness or injury b) Results in a permanent impairment of a body structure or body function c) Requires in patient hospitalization or prolongation of existing hospitalization d) Results in medical or surgical intervention to prevent permanent impairment to body structure or a body function

SERIOUS ADVERSE EVENT FORM

Patient Number

Serious Adverse Event Details

This Adverse

Event is serious because it: (tick one box only)
An adverse event that

☐ Led to death

☐ Led to serious deterioration in health of a patient, user, or other that:

a) Results in life threatening illness or injury
b) Results in a permanent impairment of a body structure or body function
c) Requires in patient hospitalization or prolongation of existing hospitalization
d) Results in medical or surgical intervention to prevent permanent impairment to body structure or a body function

Date and Description of Event (include symptoms, diagnosis and relation to study)

Name	**Signature**	**Date**

Results: Frequency and type of adverse events experienced in the usual care and enriched groups

	Usual Care Group	Enriched Group
Falls	6	3
Pneumonia	4	5
Pressure areas	1	-
Cardiac problems	11	4
Seizures	4	1
Reduced GCS	1	-
Stroke	2	1
TIA	-	-
UTI	4	2
Depression	4	1
Constipation	1	-
Malnutrition	7	3
Delirium	5	5
Other	20	2
Total:	**70**	**27**

Appendix 12 Participant Information and Consent Form Clinical Staff and Carers

Participant Information Sheet

HREC No: HREC/14/QPCH/21

Project Title:
Phase I trial: Feasibility of creating an enriched environment and subsequent impact on activity levels for stroke patients in an Acute Stroke Unit.

Name of researchers:
Mrs. Ingrid Rosbergen
Senior Physiotherapist, Nambour General Hospital, Queensland Health and MPhil Student University of Queensland
Prof. Sandy Brauer
School of Health and Rehabilitation Sciences, University of Queensland
Dr. Rohan Grimley
Senior Medical Officer, Nambour General Hospital, Queensland Health
Dr. Kathryn Hayward
School of Health and Rehabilitation Sciences, University of Queensland

You are invited to participate in the research titled 'Phase I trial: Feasibility of creating an enriched environment and subsequent impact on activity levels for stroke patients in an Acute Stroke Unit.'
This research project is studying the effect the environment has on activity levels for stroke clients in an Acute Stroke Unit.

This Participant Information contains detailed information about the research project. Its purpose is to explain to you as openly and clearly as possible all the procedures involved in this project before you decide whether or not to take part in it. This study will not affect your relations with the Nambour General Hospital or the University of Queensland if you decide not to take part.

Please read this Participant Information carefully. Feel free to ask questions about any information in this document. You may also wish to discuss the project with a relative or friend or your local doctor. Feel free to take adequate time for this. Your participation in this study is voluntary.
Once you understand what the project is about, and if you agree to take part in it, you will be asked to sign the Consent Form. By signing the Consent Form, you indicate that you understand the information and that you give your consent to participate in the research project and consent to the procedures described. You will be given a copy of this Participant Information and Consent Form to keep as a record.

Purpose and background:

Previous experience has shown that stroke clients who are managed in an organized Stroke Unit have improved functional outcomes when compared to those who are managed on a general ward. One of the reasons for these improved outcomes is the ability to commence early rehabilitation. Higher intensity treatment has shown better functional outcomes in clients recovering from stroke. However, what the ideal time of onset and optimal intensity for early rehabilitation is, is still unknown.
This study aims to determine the effect of an alternative model of early rehabilitation following stroke. The aims of this study are:

9. To study the effect of activity levels on recovery post stroke.
10. To study the effect activity levels have on complications post stroke.

11. To study if the amount of activity post stroke results in a reduction in disability.
12. To study the effect the environment has on the activity level of clients post stroke.

This study also aims to determine whether an alternative model of early rehabilitation is feasible in the Stroke Unit setting and whether this may contribute to enhancing efficacy of acute stroke client care.

Thus, one of the issues we plan to investigate is the difference in perceptions of the different rehabilitation models, where one is the traditional model and one is the alternative early rehabilitation model. We are interested in the difference in perceptions between clinical staff (e.g., therapists, nursing staff), carers and stroke survivors. By identifying such differences, we hope to gather information to answer, whether an alternative model of early rehabilitation is feasible in the Acute Stroke Unit setting. This alternative model of early rehabilitation, if deemed effective, could be applied to other Stroke Units.

Procedures:

If you agree to participate in this research project, you will be required:

Main carer:
To participate in answering a survey just prior to the patient being discharged from the Acute Stroke Unit and to assist with some questions during the telephone interview at 3 months about the patient's health and level of functioning in the time since their stroke. This telephone interview should take about 15 minutes in total.

Clinical staff:
☐ To participate in answering the staff questionnaire during the traditional model of rehabilitation, and to answer the staff questionnaire during the alternative early rehabilitation model. The questionnaires are anonymous, identical and are asking about your perception of the different models. The questionnaires will be handed out to you at specific times and you will be asked to return them within one week using the provided and addressed internal mail return envelope. The information provided will be strictly confidential.

☐ To voluntarily participate in a semi structured interview and to answer questions asked by the interviewer to determine barriers and enablers of the alternative early rehabilitation model. The interview will take approximately 60 minutes and will be audio recorded and transcribed verbatum. The interviewer is asking questions regarding your experiences and perception of the implementation of the alternative model.

Alternatives to Participation

Your participation in this research is voluntary.

Possible benefits

We cannot guarantee or promise that you will receive any direct benefit from your participation in this research. However you will be assisting us to gather information that may improve stroke care and provide better outcomes for stroke survivors.

Possible risks
We do not foresee there to be any personal risks associated with any tasks outlined in this description of research. You are free to withdraw your participation from the project at any time should you wish to, or should you experience any distress.

Confidentiality and Privacy

Your privacy and confidentiality will be maintained at all times during this research. Any information that is obtained in this study will be maintained in a secure and confidential manner and will only be disclosed with your permission, except if required by law.

No data collected will be linked or associated with any of your personal details. After the study is finished, any paper records and electronic data will be kept for a minimum of at least 7 years in accordance with the NHMRC guidelines until its confidential destruction. If you give us permission by signing the consent form, we plan to publish the results in international scientific journals. Your identity will not be disclosed in any publication or presentation.

If you experience any problems or have any questions or concerns during the study, you can contact the research staff on the telephone number provided. At your request, we can discuss your personal results with you and provide a summary of the overall results and conclusions at the completion of the study. You can also be directed to any publications arising from this research.

Withdrawal from the research

Your participation in this research is voluntary. If you wishes to withdraw consent, the Principal Investigator Mrs. Ingrid Rosbergen, should be contacted within 24 hours. At this time you will sign the revocation of consent form. Withdrawal from this study will not affect your relations with the Nambour General Hospital or the University of Queensland.

Complaints

If you wish to make a confidential complaint, which will be investigated independently of the hospital please contact Health Quality and Complaints Commission Phone 07- 31205999. Free call 1800 077 308 (outside Brisbane) or email info@hqcc.qld.gov.au

Organization of Research and Funding

This study is a partnership between researchers at the Nambour General Hospital and the School of Health and Rehabilitation Sciences, at the University of Queensland. Mrs. Ingrid Rosbergen, physiotherapist and MPhil student, is leading this research project. You will not be reimbursed for participating in this research project.

Ethics Approval

All research in Australia involving humans is reviewed by an independent group of people called a Human Research Ethics Committee (HREC). This study has been reviewed and approved by The Prince Charles Hospital, Metro North Hospital and Health Service, Human Research Ethics Committee. Should you wish to discuss any aspects of the study with someone not directly involved, you may contact the Chairperson of The Prince Charles Hospital, Human Research Ethics Committee on 07- 31394500 responsible for reviewing research.

Further Information and Contacts

We would like to thank you for your interest in the research titled:
Phase I trial: Feasibility of creating an enriched environment and subsequent impact on activity levels for stroke patients in an Acute Stroke Unit. If you would like more information about the study or if you wish to discuss any other concerns, please feel free to contact Mrs. Ingrid Rosbergen Phone 07-53703018 or email; ingrid.rosbergen@health.qld.gov.au

Participant Consent Form

HREC No:	HREC/14/QPCH/21
Project Title:	Phase I trial: Feasibility of creating an enriched environment and subsequent impact on activity levels for stroke patients in an Acute Stroke Unit
Name of Researchers:	Mrs. Ingrid Rosbergen Prof. Sandy Brauer Dr. Rohan Grimley Dr. Kathryn Hayward

I, _____ agree to participate in the above named research study and understand that I:

Carers:

- ☐ Will participate in answering a survey just prior to the patient being discharged from the Acute Stroke Unit, and to assist with some questions during the telephone interview at 3 months post stroke

Clinical staff:

- ☐ Will participate in answering the staff questionnaire during the traditional model of rehabilitation, and to answer the staff questionnaire during the alternative early rehabilitation model.
- ☐ Will participate in a semi-structured interview. The interview will take approximately 60 minutes and will be audio recorded and transcribed verbatum. The interviewer is asking questions regarding experiences and perception of the implementation of the alternative model.

- I have been informed as to the nature and extent of any risk to my health or well-being.
- I am aware that, although the project is directed to the expansion of medical knowledge generally, it may not result in any direct benefit to me.
- I have been informed that my refusal to consent to participate in the study will not affect my relations with the Nambour General Hospital or the University of Queensland
- I have been informed that I may withdraw from the project at my request at any time and that this decision will not affect in any way the quality of treatment.
- I will be given a copy of the Participant Information and Consent Form to keep.
- I have been advised that the Chief Executive, Nambour General Hospital, on recommendation from The Prince Charles Hospital, Metro North Hospital and Health Service Human Research Ethics Committee has given approval for this project to proceed.
- I am aware that I may request further information about the project as it proceeds.

- I understand that, in respect of any information obtained during the course of the project; confidentiality will be maintained to the same extent as for my Hospital medical records. In the event of any results of the project being published, I will not be identified in any way.

Participant's name: .....

Signature: ..... **Date:**
DD / MMM / YYYY

Name of Investigator: .....

Signature: ..... **Date:**
DD / MMM / YYYY

Revocation of Consent Form – Participant

HREC No:	HREC/14/QPCH/21
Project Title:	Phase I trial: Feasibility of creating an enriched environment and subsequent impact on activity levels for stroke patients in an Acute Stroke Unit
Name of Researchers:	Mrs. Ingrid Rosbergen Prof. Sandy Brauer Dr. Rohan Grimley Dr. Kathryn Hayward

- I hereby wish to WITHDRAW my consent to participate in the research project described above and understand that such withdrawal WILL NOT jeopardise any treatment or my relationship with Nambour General Hospital or the University of Queensland.

Participant's name (please print):

.....

(Signature) ..... Date:
DD / MM / YYYY

This Revocation of Consent should be forwarded to:

Mrs. Ingrid Rosbergen (Physiotherapist)
Allied Health Department
Nambour General Hospital
Nambour, Qld
4560

Appendix 13 Clinical Staff Survey

CLINICAL STAFF SURVEY

SURVEY NUMBER: _____

This survey is asking your feedback about your work experience **during the last 6 weeks in the Acute Stroke Unit**. This survey is voluntary, anonymous and strictly confidential. Your response will only be used to determine general staff perception during the study: 'Feasibility of creating an Enriched Environment and subsequent impact on activity levels for stroke patients in the Acute Stroke Unit.'
The survey should take about 15 minutes. Please tick the correct answer.
Participants must sign Participant Consent Form prior to completion of survey.

Personal Data

What is your age?
☐ under 21
☐ 21-34
☐ 35-44
☐ 45 – 54
☐ 55 or older

Which of the following best describes your position here?
☐ Clinical nurse
☐ Registered nurse
☐ Enrolled nurse
☐ Assistant in nursing
☐ Allied Health therapist
☐ Allied Health assistant

What is your gender?
☐ Male
☐ Female

How long have you worked in your profession?
☐ Less than 1 year
☐ Less than 2 years
☐ 2-5 years
☐ 5- 10 years
☐ Over 10 years

How long have you worked on the acute stroke unit?
☐ Less than 1 year
☐ Less than 2 years
☐ More than 2 years

Describe your level of agreement/disagreement with each statement
Tick one box only for each question: example

Strongly Agree				Strongly Disagree
1	2	3	4	5
☐	☐	☐	☑	☐

Attitude, innovation, autonomy

I feel I contribute to objectives of acute stroke care

Strongly Agree				Strongly disagree
1	2	3	4	5
☐	☐	☐	☐	☐

I think the quality improvement initiatives in the ward are worthwhile

Strongly Agree				Strongly disagree
1	2	3	4	5
☐	☐	☐	☐	☐

I am able to provide constructive suggestions on how the team can improve effectiveness

Strongly Agree				Strongly disagree
1	2	3	4	5
☐	☐	☐	☐	☐

I am able to make decisions in my working capacity

Strongly Agree				Strongly disagree
1	2	3	4	5
☐	☐	☐	☐	☐

Patient care

I have enough time to contribute to the patient's rehabilitation goals

Strongly Agree				Strongly disagree
1	2	3	4	5
☐	☐	☐	☐	☐

Patients in general are satisfied with the stroke care provided

Strongly Agree				Strongly disagree
1	2	3	4	5
☐	☐	☐	☐	☐

I feel that patients are getting sufficient stimulation to be active during the day

Strongly Agree				Strongly disagree
1	2	3	4	5
☐	☐	☐	☐	☐

Team relationships and work satisfaction

I feel accepted by other team members

Strongly Agree				Strongly disagree
1	2	3	4	5
☐	☐	☐	☐	☐

I take pride in the team I work with

Strongly Agree				Strongly disagree
1	2	3	4	5
☐	☐	☐	☐	☐

I enjoy the work that I do

Strongly Agree				Strongly disagree
1	2	3	4	5
☐	☐	☐	☐	☐

My physical working conditions are good

Strongly Agree				Strongly disagree
1	2	3	4	5
☐	☐	☐	☐	☐

Staff generally co-operates in order to develop and apply new ideas

Strongly Agree				Strongly disagree
1	2	3	4	5
☐	☐	☐	☐	☐

I feel that team members help each other out when necessary

Strongly Agree				Strongly disagree
1	2	3	4	5
☐	☐	☐	☐	☐

I feel part of the team working toward shared goals

Strongly Agree				Strongly disagree
1	2	3	4	5
☐	☐	☐	☐	☐

Competence/ skills and education

I am provided enough information to do the work expected of me

Strongly Agree				Strongly disagree
1	2	3	4	5
☐	☐	☐	☐	☐

I feel I have the necessary professional skills to do my job

Strongly Agree Strongly disagree

1	2	3	4	5
☐	☐	☐	☐	☐

I welcome new ideas and new ways of looking at providing stoke care

Strongly Agree Strongly disagree

1	2	3	4	5
☐	☐	☐	☐	☐

Impacts on work

I have enough time to get the required job tasks done

Strongly Agree Strongly disagree

1	2	3	4	5
☐	☐	☐	☐	☐

My source of job related stress is an excessive amount of work

Strongly Agree Strongly disagree

1	2	3	4	5
☐	☐	☐	☐	☐

I feel confident to raise issues about my workload to my supervisor

Strongly Agree Strongly disagree

1	2	3	4	5
☐	☐	☐	☐	☐

Please provide any further comments:

……
……
……
……
……
……....

Thank you for your time.
Please return within one week using the provided, and addressed as below, internal mail return envelope.
Ingrid Rosbergen
Allied Health Department- Physiotherapy
Nambour General Hospital

Appendix 14 Patient Survey

PATIENT SURVEY

This survey is asking your feedback about your experience during your admission in the Acute Stroke Unit. Your participation is voluntary.
Your feedback will be used to determine patient perception during the study: Feasibility of creating an Enriched Environment and subsequent impact on activity levels for stroke patients in the Acute Stroke Unit. The survey should take about 10 minutes. **Please circle the right answer.** Please place the survey after completion in envelope provided. Thank you.

Patient Trial Number | | | | |

1**. I felt listened to and respected by staff**

Strongly agree	Agree	Neither agree or disagree	Disagree	Strongly disagree

Comments

_____
_____

2**. I felt part of the team approach to my care**

Strongly agree	Agree	Neither agree or disagree	Disagree	Strongly disagree

Comments

_____
_____

3. I feel the rehabilitation process started in hospital

Strongly agree	Agree	Neither agree or disagree	Disagree	Strongly disagree

Comments

_____
_____

4**. I feel my time in hospital offered enough stimulation to assist my recovery**

Strongly agree	Agree	Neither agree or disagree	Disagree	Strongly disagree

Comments

_____

_____

5**. I received adequate information regarding my stroke and cause**

Strongly agree	Agree	Neither agree or disagree	Disagree	Strongly disagree

Comments

_____

_____

Appendix 15 Carer Survey

CARER SURVEY

This survey is asking your feedback about your experience during the patient's admission in the Acute Stroke Unit. Your participation is voluntary.
Your feedback will be used to determine carer's perception during the study: Feasibility of creating an Enriched Environment and subsequent impact on activity levels for stroke patients in the Acute Stroke Unit. The survey should take about 10 minutes. **Please circle the right answer.** Participants must sign Participant Consent Form prior to completion of the survey. Please place the survey after completion in envelope provided. Thank you.

Patient Trial Number ☐☐☐☐

1**. I was involved in decision making for the treatment and discharge plan**

Strongly agree	Agree	Neither agree or disagree	Disagree	Strongly disagree

Comments_____
_____

2**. I felt included in the team process**

Strongly agree	Agree	Neither agree or disagree	Disagree	Strongly disagree

Comments_____
_____

3. **I felt emotionally supported by staff**

Strongly agree	Agree	Neither agree or disagree	Disagree	Strongly disagree

Comments
_____
_____

4. **I received information regarding the cause and nature of the patient's stroke**

Strongly agree	Agree	Neither agree or disagree	Disagree	Strongly disagree

Comments

_____

_____

5**. I feel the time in hospital offered enough stimulation to assist recovery**

Strongly agree	Agree	Neither agree or disagree	Disagree	Strongly disagree

Comments

_____

_____

6**. I feel confident in my preparation to manage on discharge**

Strongly agree	Agree	Neither agree or disagree	Disagree	Strongly disagree

Comments

_____

_____

Patient Number _____Date _____

Appendix 16 Participant Data Collection Folder

Section A- Screening Eligibility Form

To be completed at time of screening

Date of Birth: | | | | | | | | | | |

Gender: Male ☐ Female ☐

Date and time of admission (24 hour clock)

Estimated date and time of stroke (24 hour clock)

Note: Record time that patient was last seen free of symptoms.

Inclusion criteria – all answers must be **YES**:

	Yes	No
▪ The patient is admitted with the diagnosis of a stroke……..		
▪ The patient requires assistance for basic ADLs at time of recruitment……..		
▪ The patient is not deteriorating in the 24 hours before recruitment……		
▪ Patient is able to sign consent or has a substitute decision maker who can sign consent……..		
▪ Patients are on the Acute Stroke Unit during their admission……		
▪ Patient can do a standing pivot or step around transfer from bed to chair with the assistance of……. 2 persons or less.		
▪ Prior to stroke patient was walking independently……		
▪ Modified Rankin Scale 2 or lower from self report……..		

Exclusion Criteria – All answers must be **NO**:

	Yes	No
▪ Pre-stroke (retrospective) modified Rankin score of 3, 4, or 5 (indicating significant disability)…….		
▪ Concurrent diagnosis of rapidly deteriorating disease (e.g. terminal cancer)……..		
▪ Patient with extensive mental health history……		

Are the Eligibility Criteria Satisfied? Yes ☐ No ☐

If YES, please proceed to the next sect

Section A- Modified Rankin Scale (MRS) - Premorbid

0. No symptoms at all.
1. No significant disability despite symptoms; able to carry out all usual duties and activities.
2. Slight disability; unable to carry out all previous activities, but able to look after own affairs without assistance.
3. Moderate disability; requiring some help, but able to walk without assistance.
4. Moderately severe disability; unable to walk without assistance, and unable to attend to own bodily needs without assistance.
5. Severe disability; (usually) bedridden, incontinent, and requiring constant nursing care and attention.
6. Dead.

Premorbid MRS Score: _____

Section A- Informed Consent: >24 and <72 hours post stroke

To be completed at time of screening.

Informed consent obtained? Yes ☐ No ☐

Date of informed consent:

Patient Number _____Date _____

Section B- Pre-Stroke Demographic Data

Marital Status: _____

Living arrangement at time of admission: _____
_____

Country of Birth: _____

Ethnic Origin: _____

Aboriginal Liaison Officer required: Yes ☐ No ☐

Language: _____

	Yes	No
Interpreter required:	☐	☐
Premorbid Mental Disability:	☐	☐

Section B- Past Medical History

1.
2.
3.
4.
5.
6.
7.
8.
9.
10.

Patient Number _____Date _____

Section B- Current Stroke Details

To be completed in consultation with Medical Team.

Has patient received rt-PA for this stroke? Yes ☐ No ☐

Is dysphagia present? Yes ☐ No ☐

Side of Brain Lesion:

☐ Left
☐ Right
☐ Brainstem
☐ None evident
☐ Unknown

Side of Symptoms:

☐ Left
☐ Right
☐ Bilateral
☐ None
☐ Unknown

Type of Stroke: Ischaemic ☐ Haemorrhagic ☐

Section B- NIH Stroke Scale

http://qheps.health.qld.gov.au/schsd/docs/clin/n1h-strokescale.pdf

Score on admission: _____

☐ Mild 0-7
☐ Moderate 8-16,
☐ Severe > 16

Score day 1 after thrombolysis:

☐ Mild 0-7
☐ Moderate 8-16,
☐ Severe > 16

☐ Not applicable

Patient Number _____Date _____

Section B- Oxford Classification

To be completed in consultation with a doctor. Scores are based on clinical assessment (not imaging results). If uncertain of classification, use boxes on left side of page to determine stroke subtype.

Total Anterior Circulatory Infarct (TACI)

All boxes should be crossed. If conscious level impaired a deficit is assumed.

Higher cerebral dysfunction e.g. dysphasia, dyscalculia, visuospatial dysfunction, neglect

☐ Homonomous hemianopia

☐ Ipsiateral motor and/or sensory loss of at least 2 areas of face, arm and leg

If all boxes above are crossed, stroke classification is TACI ----------

Partial Anterior Circulatory Infarct (PACI)

One box only should be crossed.

☐ Two of the three components of a TACI syndrome

☐ Higher cerebral dysfunction alone

☐ Motor/sensory deficit confined to one limb, or to face and hand but not whole arm

If only one box above is crossed, stroke classification is PACI ----------

Posterior Circulatory Infarct (POCI)

One or more boxes should be crossed

☐ Ipsilateral cranial nerve palsy with contralateral motor/sensory deficit

☐ Bilateral motor/sensory deficit

☐ Disorder of the conjugate eye movement

☐ Cerebellar dysfunction without ipsilateral weakness i.e. not ataxic hemiparesis

☐ Isolated homonymous visual field deficit

If one or more boxes above are crossed, stroke classification is POCI----------

Lacumar Circulation Infarct (LACI)

All boxes should be crossed

☐ Pure motor stroke *or* pure sensory stroke *or* sensori-motor *or* ataxic hemiparesis

☐ Two of three areas (face, arm or leg) must be involved, with any limb involvement being the whole limb affected

☐ Absence of cortical signs (as defined in PACI, TACI)

☐ Absence of brainstem signs (as defined in POCI)

If all boxes are crossed, stroke classification is LACI----------

Haemorrhage----------

Section B- Modified Rankin Scale (MRS) – Current Admission

0. No symptoms at all.
1. No significant disability despite symptoms; able to carry out all usual duties and activities.
2. Slight disability; unable to carry out all previous activities, but able to look after own affairs without assistance.
3. Moderate disability; requiring some help, but able to walk without assistance.
4. Moderately severe disability; unable to walk without assistance, and unable to attend to own bodily needs without assistance.
5. Severe disability; (usually) bedridden, incontinent, and requiring constant nursing care and attention.
6. Dead.

MRS Score: _____

Section B- 10 – Meter Walk Test

The 10-meter walk test assesses walking ability in a controlled environment.

The individual walks a total of 14 meters. A 'flying start' is used where the individual may accelerate 2 meters before entering the 10-meter distance and 2 meters to decelerate afterwards. Speed is only calculated for the 10m distance between the end zones.

The time commences when the toes of the leading foot cross the 2-meter mark and stops when the toes of the leading foot cross the 12-meter mark. The patient can use an assistive device and should walk as fast as possible.

☐ Unable to do

☐ Time: ___ ___: ___ ___seconds

Walking Aid: ☐ Nil ☐ SPS ☐ 4 WW ☐ Other: _____

Patient's Weight: ___ ___ ___. ___kg

Patient Number _____Date _____

Section B- Mobility Scale Acute Stroke– Current Admission

Rating Scale

1 Unable to do the activity: patient makes no contribution to the activity or is unable to complete the activity.

2 Maximum assistance of 1 or 2 people: patient makes minimal contribution to the activity.

3 Moderate assistance of 1 person: hands on assistance for most of the activity. The patient is able to perform a part of the activity independently.

4 Minimal assistance: hands on for part of the activity.

5 Supervised: verbal input, no hands on assistance, physiotherapist prepared to give assistance.

6 Unassisted and safe: no verbal input.

Activities

1. Bridging from supine, buttocks clear of bed, return to supine

Rating: ☐1 ☐2 ☐ 3 ☐4 ☐ 5 ☐ 6

2. Sitting from supine, legs over the side of the body, let the patient choose the side, return to supine.

Rating: ☐1 ☐2 ☐ 3 ☐4 ☐ 5 ☐ 6

3. Balanced sitting for 3 minutes maximum base of support, defined as thighs in contact with the couch, flexor aspect of knees in contact with the edge of the couch, legs at right angles to thighs, feet supported on a stool/floor at right angles to the legs. The bed height may be adjusted to achieve the correct position; a footstool may be used when the patient's feet do not reach the floor.

Rating: ☐1 ☐2 ☐ 3 ☐4 ☐ 5 ☐ 6

4. Sit to vertical stand from a chair (height 43 cm) with no arm rest.

Rating: ☐1 ☐2 ☐ 3 ☐4 ☐ 5 ☐ 6

5. Balanced standing for 1 minute (to be performed from the chair), only assess standing, not sit to stand.

Rating: ☐1 ☐2 ☐ 3 ☐4 ☐ 5 ☐ 6

6. Gait, assessed indoors on level surface, along a measured walkway of 10m, with or without a gait aid.

Rating: ☐1 ☐2 ☐ 3 ☐4 ☐ 5 ☐ 6

Section B- Modified Barthel Index

ADL Items	Score	Comments
Personal Hygiene	☐ 0 ☐ 1 ☐ 3 ☐ 4 ☐ 5	
Bathing Self	☐ 0 ☐ 1 ☐ 3 ☐ 4 ☐ 5	
Feeding	☐ 0 ☐ 2 ☐ 5 ☐ 8 ☐ 10	
Toilet Management	☐ 0 ☐ 2 ☐ 5 ☐ 8 ☐ 10	
Stair Climbing	☐ 0 ☐ 2 ☐ 5 ☐ 8 ☐ 10	
Dressing	☐ 0 ☐ 2 ☐ 5 ☐ 8 ☐ 10	
Bowel Control	☐ 0 ☐ 2 ☐ 5 ☐ 8 ☐ 10	
Bladder Control	☐ 0 ☐ 2 ☐ 5 ☐ 8 ☐ 10	
Ambulation	☐ 0 ☐ 3 ☐ 8 ☐12 ☐ 15	
Wheelchair Management	☐ 0 ☐ 1 ☐ 3 ☐ 4 ☐ 5	
Chair / Bed Transfers	☐ 0 ☐ 3 ☐ 8 ☐12 ☐ 15	
TOTAL:	**/100**	
DEPENDENCE LEVEL:		

DEPENDENCE LEVEL (Shah, 1989)	
0 – 20	Total Dependence
21 – 60	Severe Dependence
61 – 90	Moderate Dependence
91 – 99	Slight Dependence
100	Independent of assistance from others

Patient Number _____Date _____

EESI

Section B-

Hospital Anxiety and Depression Scale

Doctors are aware that emotions play an important part in most illnesses. If your doctor knows about these feelings, they will be able to help you more
This questionnaire is designed to help your doctor to know how you feel.
Read each item and place a firm tick in the box opposite the reply which comes closest to how you have been feeling in the past week.
Don't take too long over your replies: your immediate reaction to each item will probably be more accurate than a long thought-out response.

Tick only one box in each section

I feel tense or "wound up"

Most of the time	3
A lot of the time	2
From time to time, occasionally	1
Not at all	0

I still enjoy the things I used to enjoy

Definitely as much	0
Not quite as much	1
Only a little	2
Hardly at all	3

I get a sort of frightened feeling as if something awful is about to happen

Very definitely and quite badly	3
Yes, but not too badly	2
A little, but it doesn't worry me	1
Not at all	0

I can laugh and see the funny side of things

As much as I always could	0
Not quite as much now	1
Definitely not so much now	2
Not at all	3

Worrying thoughts go through my mind

A great deal of the time	3
A lot of the time	2
Not too often	1
Very little	0

I feel cheerful

Never	3
Not often	2
Sometimes	1
Most of the time	0

I can sit at ease and feel relaxed

Definitely	0
Usually	1
Not often	2
Not at all	3

A	D

I feel as if I am slowed down

Nearly all the time	3
Very Often	2
Sometimes	1
Not at all	0

I get a sort of frightened feeling like "butterflies" in the stomach

Not at all	0
Occasionally	1
Quite often	2
Very often	3

I have lost interest in my appearance

Definitely	3
I don't take as much care as I should	2
I may not take as much care	1
I take just as much care as ever	0

I feel restless as if I have to be on the move

Very much indeed	3
Quite a lot	2
Not very much	1
Not at all	0

I look forward with enjoyment to things

As much as ever I did	0
Rather less than I used to	1
Definitely less than I used to	2
Hardly at all	3

I get sudden feelings of panic

Very often indeed	3
Quite often	2
Not very often	1
Not at all	0

I can enjoy a good book or radio or television program

Often	0
Sometimes	1
Not often	2
Very seldom	3

Total

A	D

A	D

Scoring: On either the Depression or Anxiety Subscales, the following severity levels apply:
8-10 mild, 11-14 moderate, 15+ severe

HOSPITAL ANXIETY & DEPRESSION SCALE

Patient Number _____Date _____

Section C- Mobility Scale Acute Stroke– Day 7, 14, 21 …

Rating Scale

1 Unable to do the activity: patient makes no contribution to the activity or is unable to complete the activity.

2 Maximum assistance of 1 or 2 people: patient makes minimal contribution to the activity.

3 Moderate assistance of 1 person: hands on assistance for most of the activity. The patient is able to perform a part of the activity independently.

4 Minimal assistance: hands on for part of the activity.

5 Supervised: verbal input, no hands on assistance, physiotherapist prepared to give assistance.

6 Unassisted and safe: no verbal input.

Activities

1. Bridging from supine, buttocks clear of bed, return to supine

Rating: ☐1 ☐2 ☐ 3 ☐4 ☐ 5 ☐ 6

2. Sitting from supine, legs over the side of the body, let the patient choose the side, return to supine.

Rating: ☐1 ☐2 ☐ 3 ☐4 ☐ 5 ☐ 6

3. Balanced sitting for 3 minutes maximum base of support, defined as thighs in contact with the couch, flexor aspect of knees in contact with the edge of the couch, legs at right angles to thighs, feet supported on a stool/floor at right angles to the legs. The bed height may be adjusted to achieve the correct position; a footstool may be used when the patient's feet do not reach the floor.

Rating: ☐1 ☐2 ☐ 3 ☐4 ☐ 5 ☐ 6

4. Sit to vertical stand from a chair (height 43 cm) with no arm rest.

Rating: ☐1 ☐2 ☐ 3 ☐4 ☐ 5 ☐ 6

5. Balanced standing for 1 minute (to be performed from the chair), only assess standing, not sit to stand.

Rating: ☐1 ☐2 ☐ 3 ☐4 ☐ 5 ☐ 6

6. Gait, assessed indoors on level surface, along a measured walkway of 10m, with or without a gait aid.

Rating: ☐1 ☐2 ☐ 3 ☐4 ☐ 5 ☐ 6

Section C- Modified Rankin Scale (MRS) – Day 7, 14, 21 ….

0 No symptoms at all.
1 No significant disability despite symptoms; able to carry out all usual duties and activities.
2 Slight disability; unable to carry out all previous activities, but able to look after own affairs without assistance.
3 Moderate disability; requiring some help, but able to walk without assistance.
4 Moderately severe disability; unable to walk without assistance, and unable to attend to own bodily needs without assistance.
5 Severe disability; (usually) bedridden, incontinent, and requiring constant nursing care and attention.
6 Dead.

MRS Score: _____

Patient Number _____Date _____

Section D- Patient Contact Detail Form

Name:	*(patient sticker)*
URN:	
Date of Birth:	
Date of Stroke:	
Address:	
Contact no. 1:	**Contact no. 2:**

Next of Kin:	
Relationship:	
Contact no. 1:	**Contact no. 2:**

Date of Discharge from Hospital:
Discharge Destination:

Section E - Blinded Assessor Handover Information

Name/URN/DOB	*(patient sticker)*
Date of Stroke:	
Initial and current presentation	
Past med Hx	**Social Hx**

Current transfer Status
D/C destination

Patient Number _____Date _____

Section E- Modified Rankin Scale (MRS) – Discharge

0 No symptoms at all.
1 No significant disability despite symptoms; able to carry out all usual duties and activities.
2 Slight disability; unable to carry out all previous activities, but able to look after own affairs without assistance.
3 Moderate disability; requiring some help, but able to walk without assistance.
4 Moderately severe disability; unable to walk without assistance, and unable to attend to own bodily needs without assistance.
5 Severe disability; (usually) bedridden, incontinent, and requiring constant nursing care and attention.
6 Dead.

MRS Score: _____

Section E - 10 – Meter Walk Test- Discharge

The 10-meter walk test assesses walking ability in a controlled environment.
The individual walks a total of 14 meters. A 'flying start' is used where the individual may accelerate 2 meters before entering the 10-meter distance and 2 meters to decelerate afterwards. Speed is only calculated for the 10m distance between the end zones.
The time commences when the toes of the leading foot cross the 2-meter mark and stops when the toes of the leading foot cross the 12-meter mark. The patient can use an assistive device and should walk as fast as possible.

☐ Unable to do

☐ Time: ___ ___: ___ ___seconds

Walking Aid: ☐ Nil ☐ SPS ☐ 4 WW ☐ Other: _____

Patient's Weight: ___ ___ ___. ___kg

Patient Number _____Date _____

Section E - Mobility Scale Acute Stroke– Discharge

Rating Scale

1 Unable to do the activity: patient makes no contribution to the activity or is unable to complete the activity.

2 Maximum assistance of 1 or 2 people: patient makes minimal contribution to the activity.

3 Moderate assistance of 1 person: hands on assistance for most of the activity. The patient is able to perform a part of the activity independently.

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Activities

1. Bridging from supine, buttocks clear of bed, return to supine

Rating: ☐1 ☐2 ☐ 3 ☐4 ☐ 5 ☐ 6

2. Sitting from supine, legs over the side of the body, let the patient choose the side, return to supine.

Rating: ☐1 ☐2 ☐ 3 ☐4 ☐ 5 ☐ 6

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Rating: ☐1 ☐2 ☐ 3 ☐4 ☐ 5 ☐ 6

4. Sit to vertical stand from a chair (height 43 cm) with no arm rest.

Rating: ☐1 ☐2 ☐ 3 ☐4 ☐ 5 ☐ 6

5. Balanced standing for 1 minute (to be performed from the chair), only assess standing, not sit to stand.

Rating: ☐1 ☐2 ☐ 3 ☐4 ☐ 5 ☐ 6

6. Gait, assessed indoors on level surface, along a measured walkway of 10m, with or without a gait aid.

Rating: ☐1 ☐2 ☐ 3 ☐4 ☐ 5 ☐ 6

Section E- Modified Barthel Index- Discharge

ADL Items	Score	Comments
Personal Hygiene	☐ 0 ☐ 1 ☐ 3 ☐ 4 ☐ 5	
Bathing Self	☐ 0 ☐ 1 ☐ 3 ☐ 4 ☐ 5	
Feeding	☐ 0 ☐ 2 ☐ 5 ☐ 8 ☐ 10	
Toilet Management	☐ 0 ☐ 2 ☐ 5 ☐ 8 ☐ 10	
Stair Climbing	☐ 0 ☐ 2 ☐ 5 ☐ 8 ☐ 10	
Dressing	☐ 0 ☐ 2 ☐ 5 ☐ 8 ☐ 10	
Bowel Control	☐ 0 ☐ 2 ☐ 5 ☐ 8 ☐ 10	
Bladder Control	☐ 0 ☐ 2 ☐ 5 ☐ 8 ☐ 10	
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Wheelchair Management	☐ 0 ☐ 1 ☐ 3 ☐ 4 ☐ 5	
Chair / Bed Transfers	☐ 0 ☐ 3 ☐ 8 ☐12 ☐ 15	
TOTAL:	**/100**	
DEPENDENCE LEVEL:		

DEPENDENCE LEVEL (Shah, 1989)	
0 – 20	Total Dependence
21 – 60	Severe Dependence
61 – 90	Moderate Dependence
91 – 99	Slight Dependence
100	Independent of assistance from others

Patient Number _____Date _____

EESI

Section E- Discharge

Hospital Anxiety and Depression Scale

V2.0 - 06/2013
SOURCE: IntPrint

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All clinical forms creation & amendments must be conducted through Health Information Unit

HOSPITAL ANXIETY & DEPRESSION SCALE

Doctors are aware that emotions play an important part in most illnesses. If your doctor knows about these feelings, they will be able to help you more

This questionnaire is designed to help your doctor to know how you feel.

Read each item and place a firm tick in the box opposite the reply which comes closest to how you have been feeling in the past week.

Don't take too long over your replies: your immediate reaction to each item will probably be more accurate than a long thought-out response.

Tick only one box in each section

I feel tense or "wound up"

Most of the time	3
A lot of the time	2
From time to time, occasionally	1
Not at all	0

I still enjoy the things I used to enjoy

Definitely as much	0
Not quite as much	1
Only a little	2
Hardly at all	3

I get a sort of frightened feeling as if something awful is about to happen

Very definitely and quite badly	3
Yes, but not too badly	2
A little, but it doesn't worry me	1
Not at all	0

I can laugh and see the funny side of things

As much as I always could	0
Not quite as much now	1
Definitely not so much now	2
Not at all	3

Worrying thoughts go through my mind

A great deal of the time	3
A lot of the time	2
Not too often	1
Very little	0

I feel cheerful

Never	3
Not often	2
Sometimes	1
Most of the time	0

I can sit at ease and feel relaxed

Definitely	0
Usually	1
Not often	2
Not at all	3

A	D

I feel as if I am slowed down

Nearly all the time	3
Very Often	2
Sometimes	1
Not at all	0

I get a sort of frightened feeling like "butterflies" in the stomach

Not at all	0
Occasionally	1
Quite often	2
Very often	3

I have lost interest in my appearance

Definitely	3
I don't take as much care as I should	2
I may not take as much care	1
I take just as much care as ever	0

I feel restless as if I have to be on the move

Very much indeed	3
Quite a lot	2
Not very much	1
Not at all	0

I look forward with enjoyment to things

As much as ever I did	0
Rather less than I used to	1
Definitely less than I used to	2
Hardly at all	3

I get sudden feelings of panic

Very often indeed	3
Quite often	2
Not very often	1
Not at all	0

I can enjoy a good book or radio or television program

Often	0
Sometimes	1
Not often	2
Very seldom	3

Total

A	D

A	D

Scoring: On either the Depression or Anxiety Subscales, the following severity levels apply:
8-10 mild, 11-14 moderate, 15+ severe

Section F – End of Intervention Form

This form must be completed for all patients in the study including patients recruited to standard care or intervention.

When did the patient complete the intervention?

Date and time intervention completed: _____/ _____/ _____ Time: _____

Reason for completing intervention?

Patient was discharged home ☐

Patient was discharged to rehabilitation ☐

Patient was transferred to another ward ☐

Patient was palliated ☐

Patient deceased ☐

Patient experienced an adverse event ☐

Other (please specify) ☐

_____

Patient Number _____Date _____

Section F – Blinded Assessor Telephone Interview 3 months

Personal Information

Phone follow up (3 months) with ☐ patient ☐ carer ☐ both

Patient Sticker

Introduction:

Hello my name is…….. I am phoning in regards to the trial that you agreed to participate in whilst in hospital post your stroke. We are very pleased you have participated and I would like to ask you some follow up questions if you have time available. If you are busy I can make an appointment for another time that is suitable for you.

Repeat Trial information:

This study aims to determine the effect of an alternative model of early rehabilitation following stroke. It will study the effect activity levels have on recovery post stroke. During you inpatient stay we have gathered information about your activity levels. Now 3 months after your stroke we would like to hear how you are functioning.

Personal details if changed: question 'do you live at the same address as before your stroke? Repeat address on patient sticker

Address type: change in type of housing? Home/ unit/ care other

Street address
Suburb
Post code
State
Phone number

Patient Number _____Date _____

1. Where are you staying at present?

☐ Hospital

☐ Rehabilitation (inpatient)

☐ Hostel Care

☐ Nursing Home

☐ Home with care supports (assistance from family or care providers)

☐ Home without care supports

☐ Transitional care service Residential

☐ Other

2. Do you live on your own?

☐ Yes I live alone

☐ No I live with others.

3. If you are receiving care support, what type and amount do you get?

_____

_____

_____

4. Since you were in hospital for your stroke, have you been readmitted again to a hospital or did you have a serious medical event?

☐ Yes ☐ No

If yes, what was the reason for admission?

_____

_____

Date of event or re- admission or serious event:

_____

Patient Number _____Date _____

Which of these best describes the patient level of disability today (tick one box only) Utilize questions on next page to illicit best response

Modified Rankin Scale

☐ 0 = No symptoms at all
☐ 1 = No significant disability despite symptoms; able to carry out all usual duties and activities
☐ 2 = Slight disability; unable to carry out all previous activities, but able to look after own affairs without assistance
☐ 3 = Moderate disability requiring some help, but able to walk without assistance
☐ 4 = Moderate severe disability; unable to walk without assistance and unable to attend to own bodily needs without assistance
☐ 5 = Severe disability; bedridden, incontinent, and requiring constant nursing care and attention

Health State Score: Could you give your health state a score where 0 is not healthy at all and 100 is in the best healthy score.

_____ (number needs to be between 0 and 100)

If there are any concerns or issues that have arisen since your discharge would you consent to being contacted by a member of the Acute Stroke Team.

☐ Yes ☐ No ☐ N/A

I have no further questions. The research team wants to say a big thank you for your participation and contribution. It is much appreciated.

Form Completion:

Name:
Signature:
Date:
Time: